The Basic NIUSR Functional Model for WMD Incident Operational Management

Bobby Hartway
Chair, Requirements Committee
NIUSR

June 2001

www.niusr.org

Lois Clark McCoy
President

Register for our
NIUSR Fall 2001 International Conference
Huntsville, Alabama
See details

Members: Please update personal contact information on-line.

Contact us
Lois.McCoy@NIUSR.org
Webmaster@NIUSR.org

National Institute for Urban Search and Rescue

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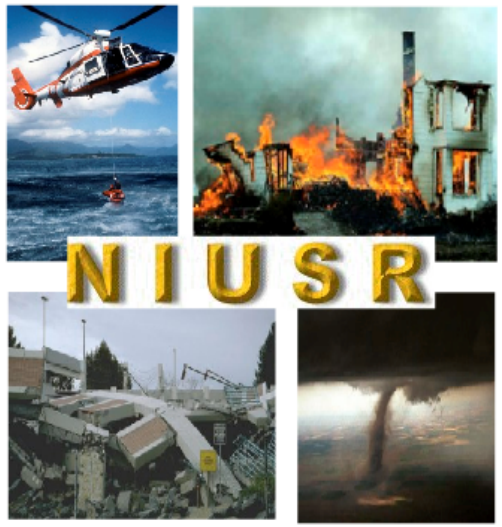
Welcome, please enter



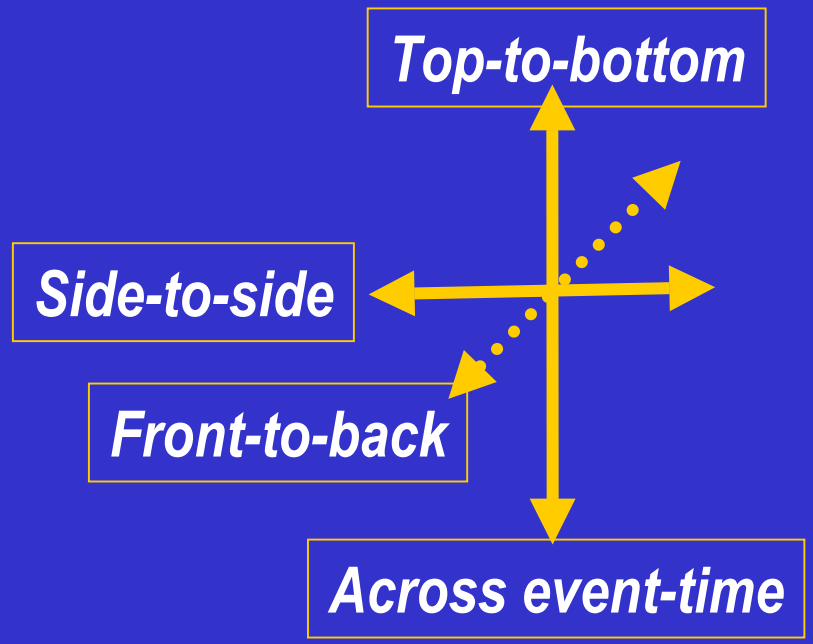
Welcome, please enter

Please check out the Fall Conference in Huntsville, AL

Three Key Ingredients of Requirements Documentation

The most import aspects of developing good requirements are . . .

1) **Structure**
2) **Structure**
3) **Structure**



Ideally, structures with scalable, hierarchical, multidimensional, cross-relational attributes . . .

FEMA's Federal Response Plan Pyramid Model

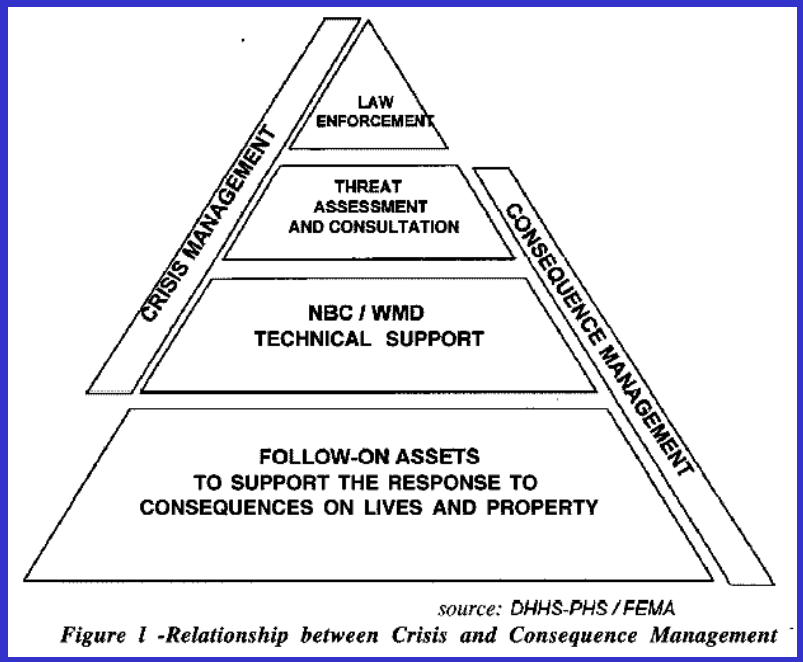
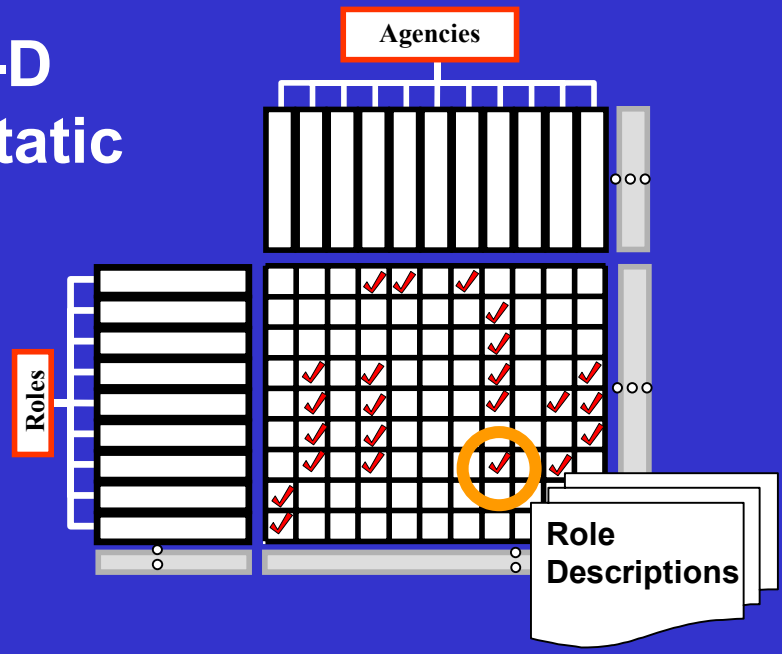


Figure 1 -Relationship between Crisis and Consequence Management

2-D Static



A 2-D Static Model can't account for the evolving nature of WMD Incident parameters across time and space. It is a fixed viewpoint of the Emergency Response "System".

There are pyramids and there are pyramids

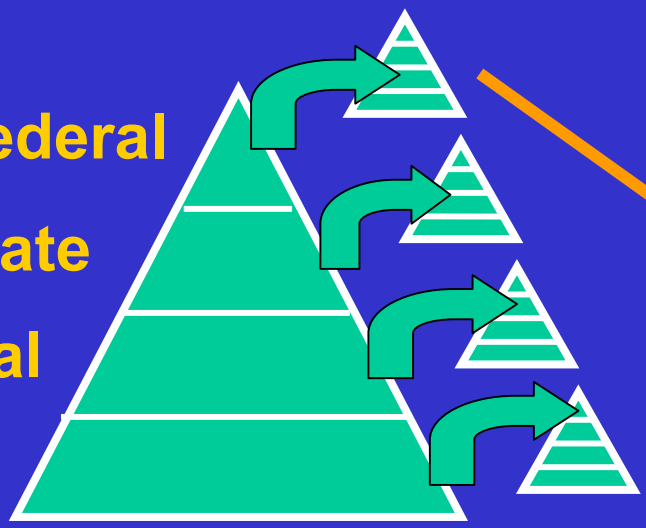
Each Jurisdictional Group is Autonomous, and has its own levels of operational functionality

Federal

State

Regional

Local



Law –
what may be done

Operations –
what can be done

Response –
what must be done

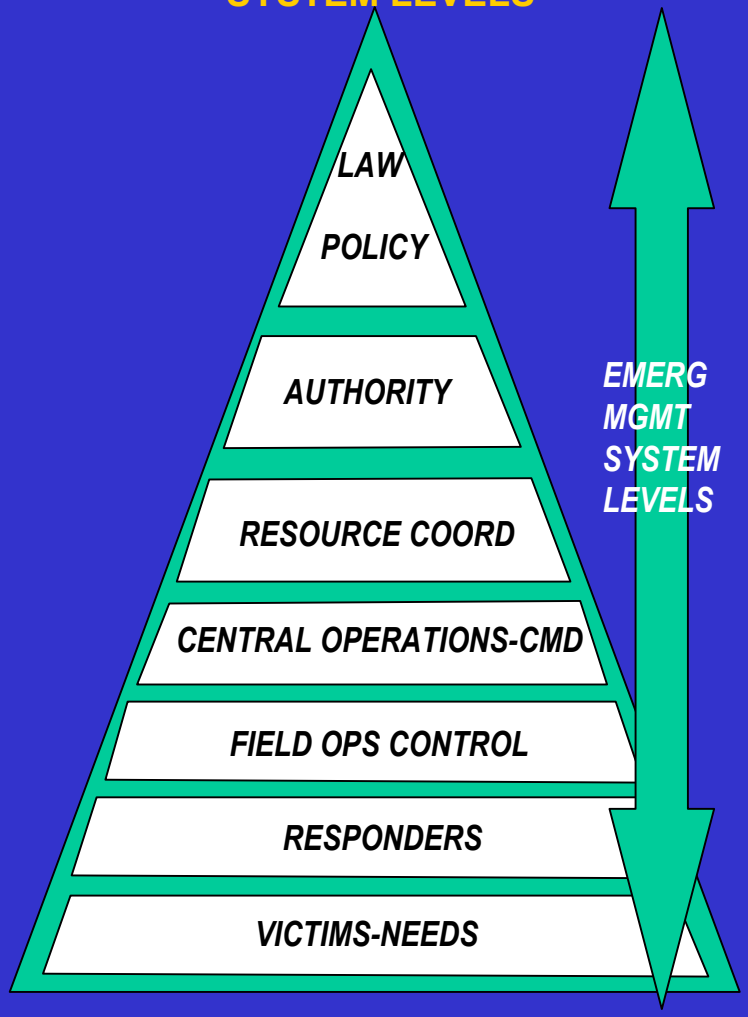
Incident –
Victims needs & timing

What are these levels?

- National Hierarchy of Jurisdictional levels or groups

CONCEPT OF COMMAND PROTOCOL LEVELS

(NGO, Industry, and Medical Community Views Not Shown Here for Simplicity)



Types of Organizations

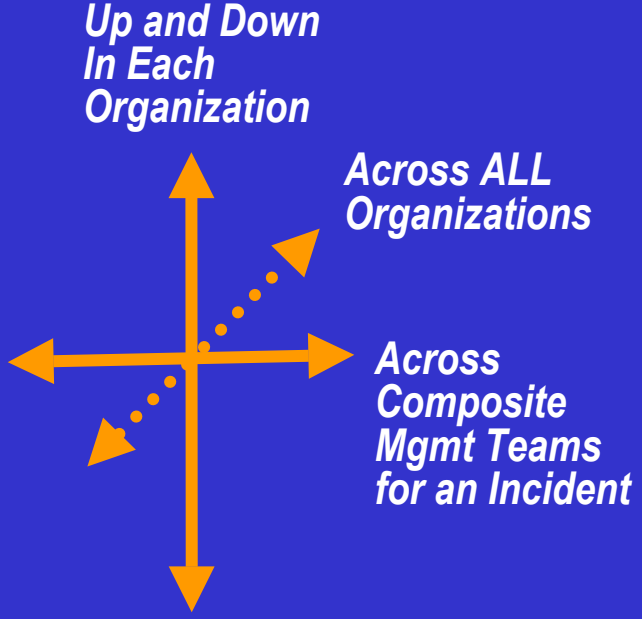
STATE GOV'T	FED GOV'T -CIVILIAN	FED GOV'T -DoD
	FED LAW	*FED LAW*
STATE LAW		
STATE POLICY	*U.S. POLICY*	*DoD POLICY and DOCTRINE*
STATE Agency Authority	*FEDERAL Agency Authority*	*Agency-Policy, Service-Doctrine*
STATE Agency Coordination	*FEDERAL Agency Coordination*	*STRATEGIC CMD*
LOCAL Govt Agency Coord	*FEDERAL Field Liaison*	*TACTICAL CMD*
EMC C2	*Fed Field Ofc*	*FIELD OPS CMD*
Field ICS	*Field ICS*	
State-Local Response Teams	*Federal Response Teams*	*Agency or Service Response Teams*

Notice that all organizational views span all levels, from law at the top to victims needs at the bottom!

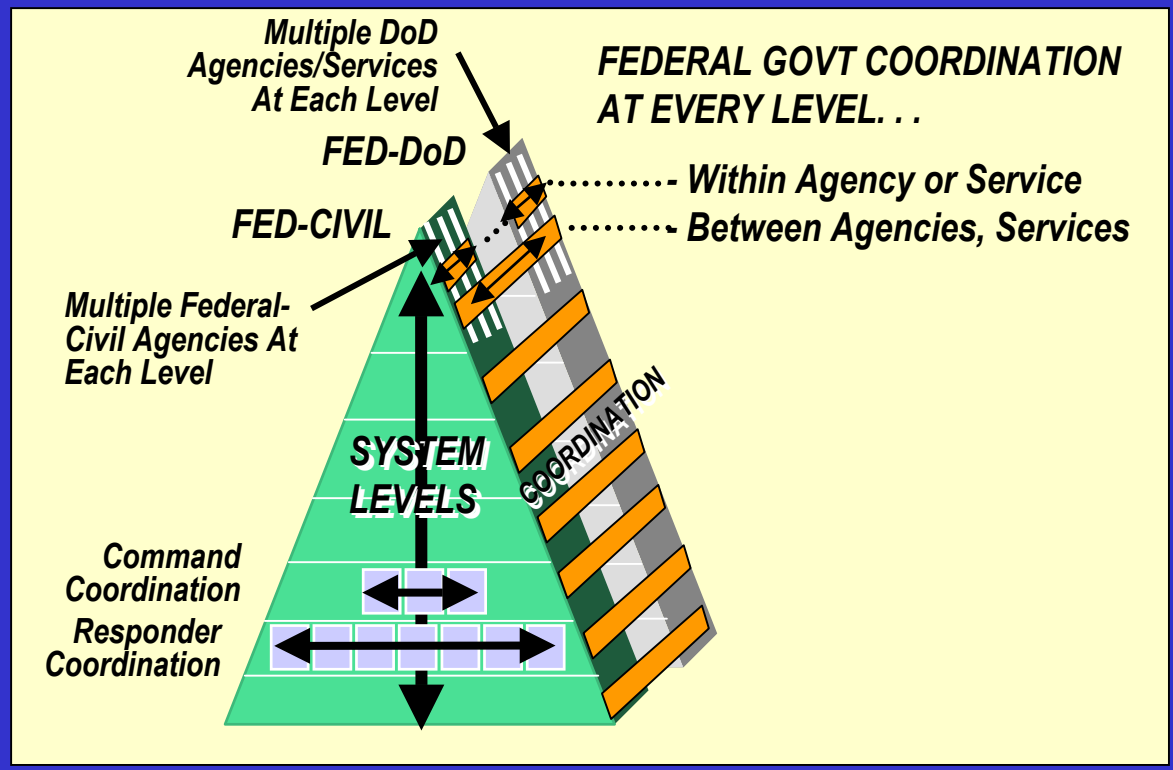
FEDERAL GOVERNMENT COORDINATION

- "Federal" Includes Civilian and Military Agencies-

DIMENSIONS OF COORDINATION



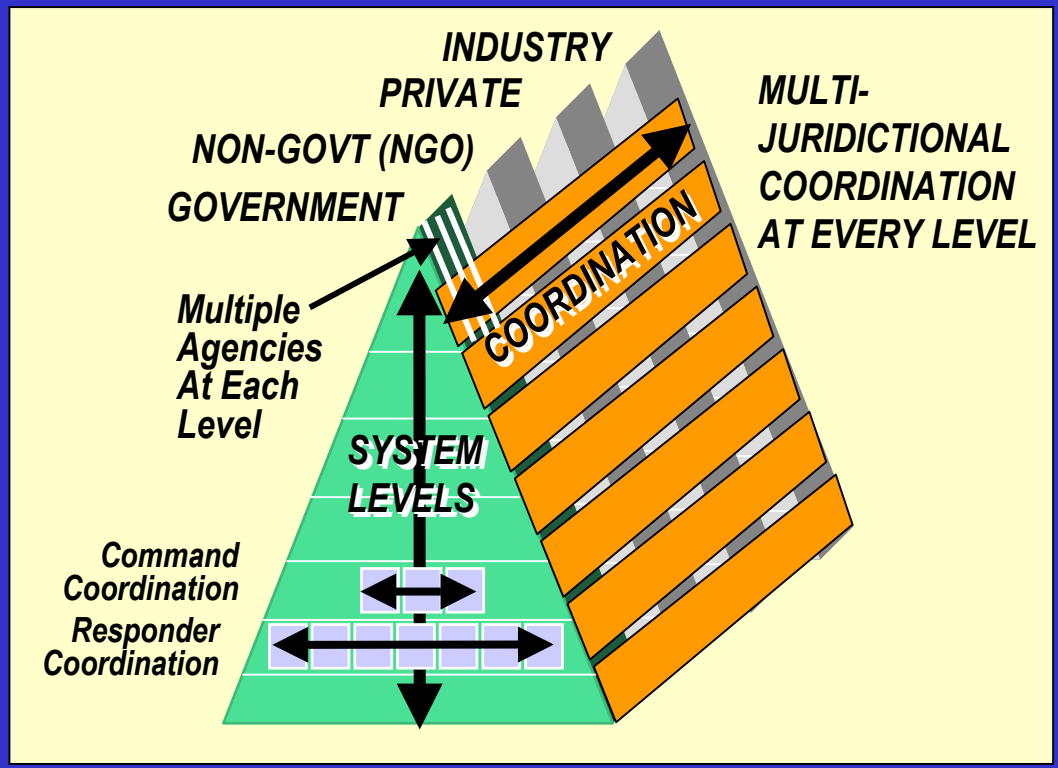
ORGANIZATIONAL - OPERATIONAL INCIDENT COORDINATION *



** For Simplicity the State, Industry, and NGO domains are not shown here*

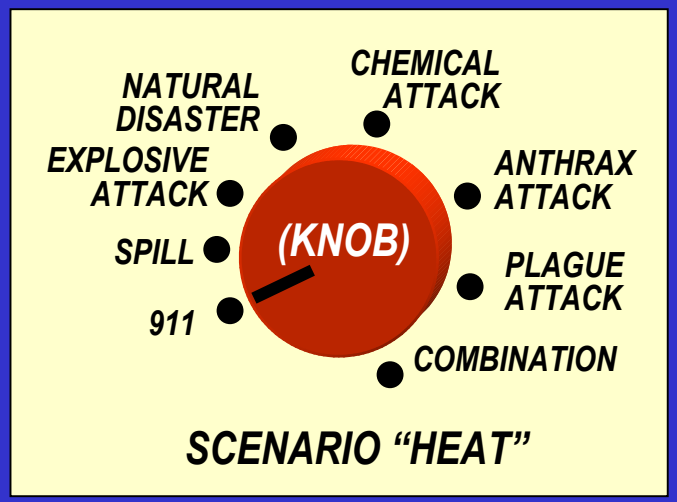
CONCEPT OF MULTI-JURISDICTIONAL COORDINATION vs. SCENARIO TYPE & OPERATIONAL PHASE

INCIDENT OPERATIONAL COORDINATION

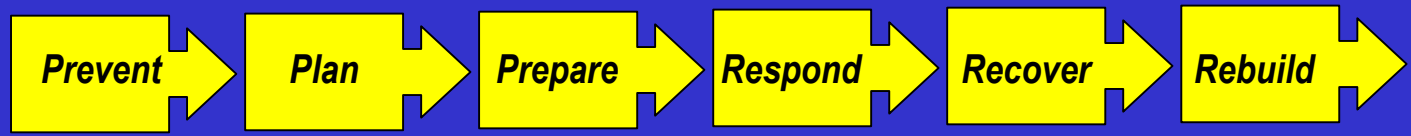


Incident operational coordination is different for every type of scenario and for each operational phase of a scenario

TYPES OF SCENARIOS

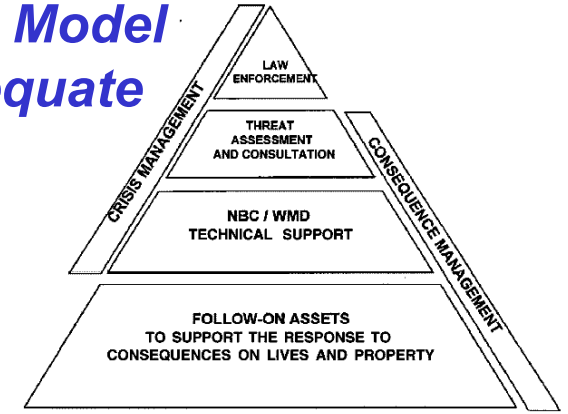


INCIDENT OPERATIONAL PHASES



The NIUSR Information-Model for WMD Incident Management

. . . FRP Model is Inadequate



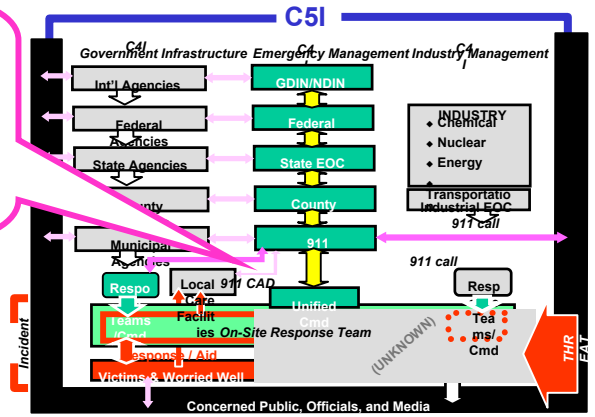
source: DHHS-PHS / FEMA

Figure 1 -Relationship between Crisis and Consequence Management

The FRP model emphasizes Static, two-dimensional Jurisdictional Ownerships and Responsibilities only. . operational functionality is over-simplified and in narrative form only - no dynamic features!

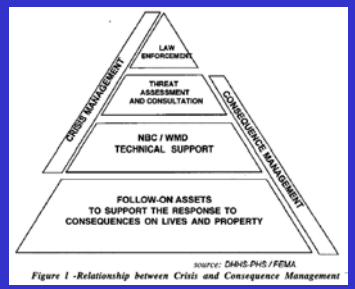
. . . The NIUSR Extreme Information Infrastructure (XII) Interoperability Model Provides a Basis for Dynamic WMD Incident Command & Knowledge Management

Purple arrows represent flow of incident knowledge using interoperable communications links of all kinds:
- telephone, fax, radio, computer



The NIUSR Information Model emphasizes Dynamic information interfaces that support situation-knowledge coordination and a common operational-situational view

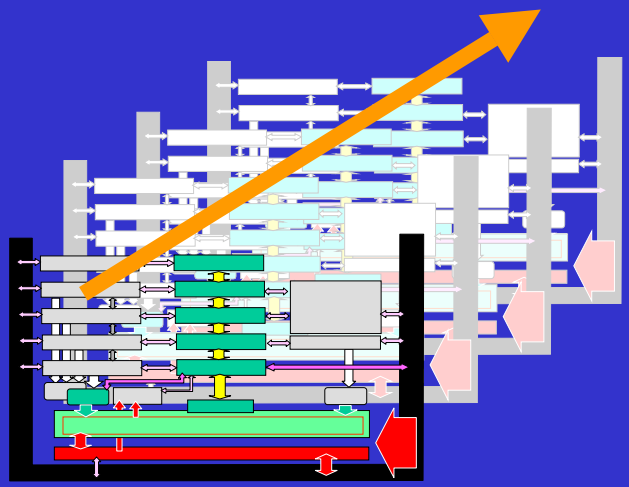
Static Models vs. Dynamic Models



Static

A Static Model doesn't account for the evolving nature of WMD Incident across time and space. It is a fixed viewpoint of the Emergency Response "System".

WMD Incident Evolution

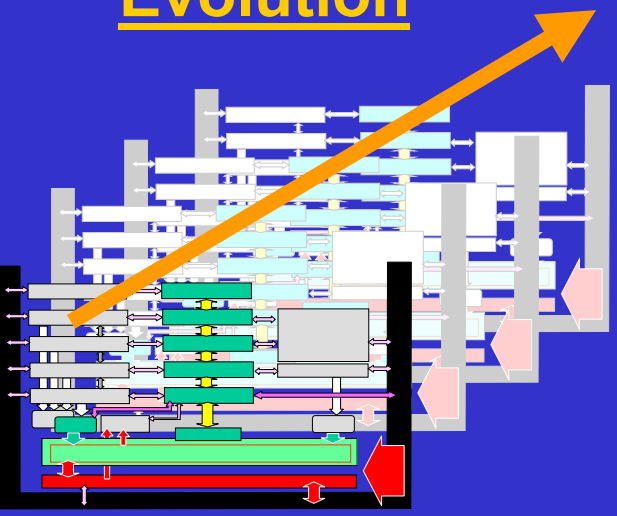


Dynamic

A Dynamic model accounts for multiple dimensions across time and space, and through operational organization evolution . . . including evolving command protocols.

Dynamic Model Dimensions

WMD Incident Evolution

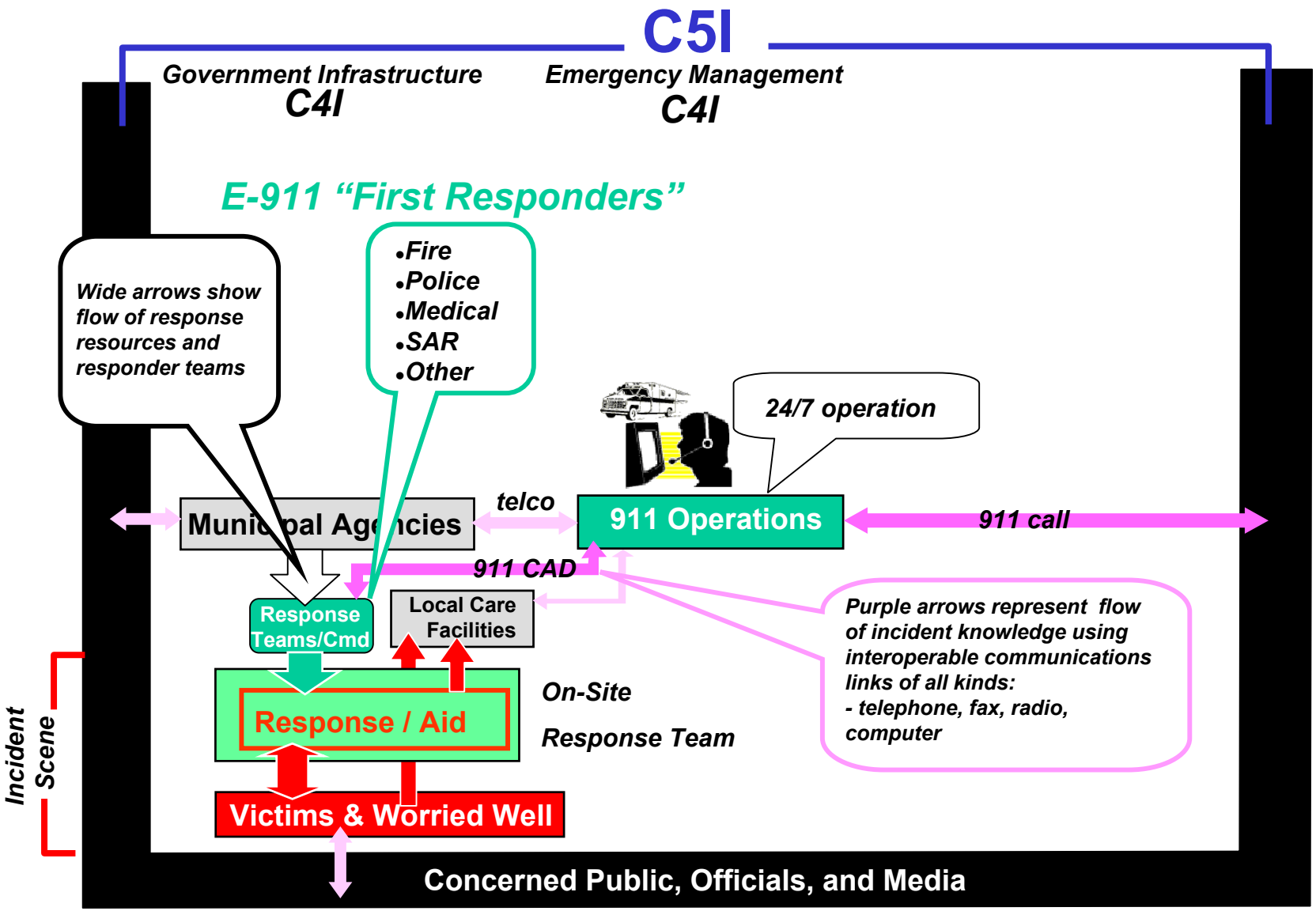


Dynamic

- From LOCAL 911 coordination at bottom to International cooperation at top
- Across all threats (All-Hazards, including all WMD)
- Across all jurisdictions and types of participants from law to medicine
- Across all essential elements of information and communication needs
- Across all operational phases from analysis, to planning, to training, to exercise, to execution, to resolution
- Across all evolutionary changes of command protocols from small incident to catastrophic medical emergency

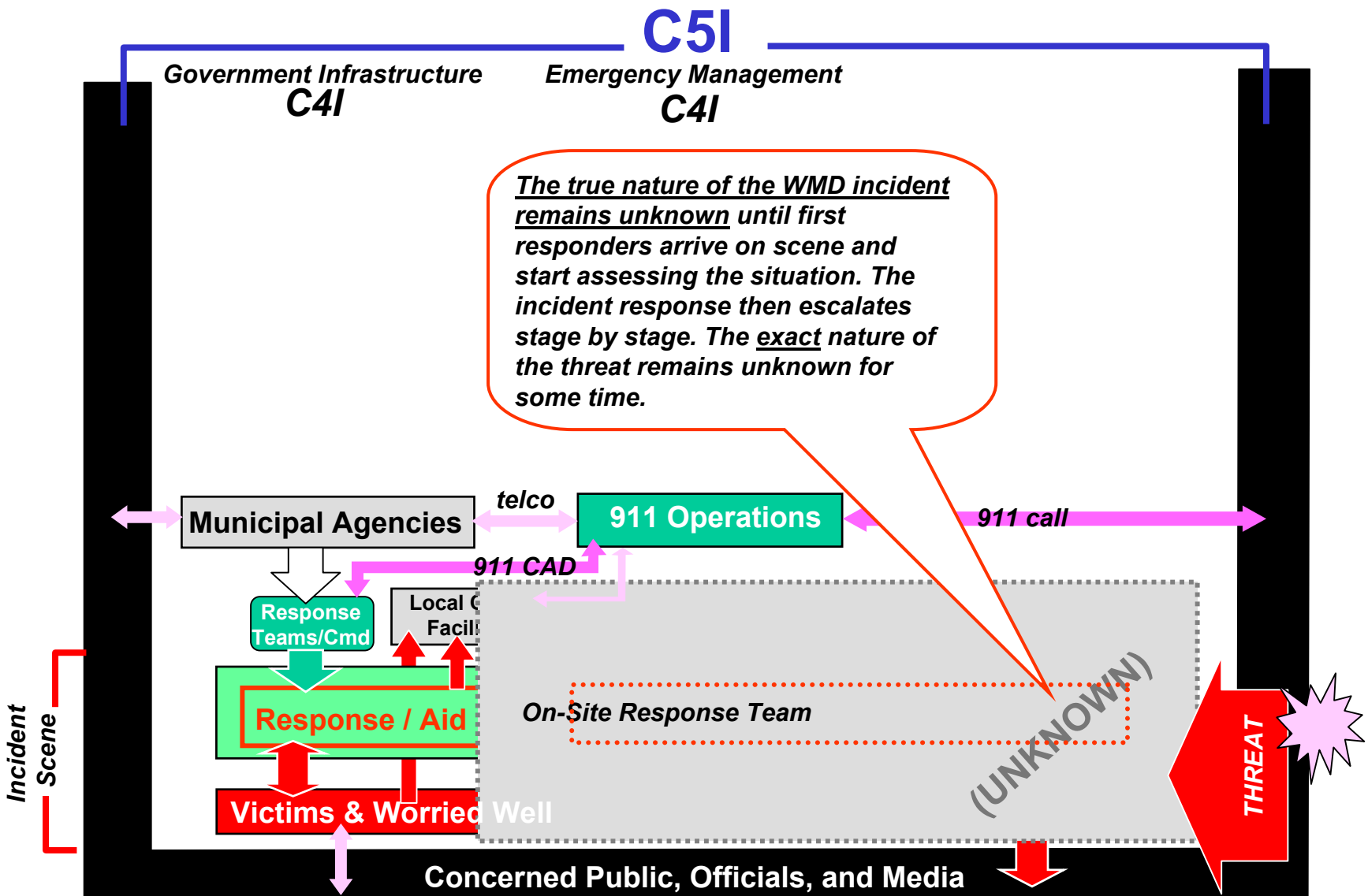
Using XII Model to Show Basic E-911 Emergency Interfaces

- Basic Computer-Aided-Dispatch (CAD) for Everyday Incidents -



Modeling The Beginning Phase of a Chemical WMD Incident

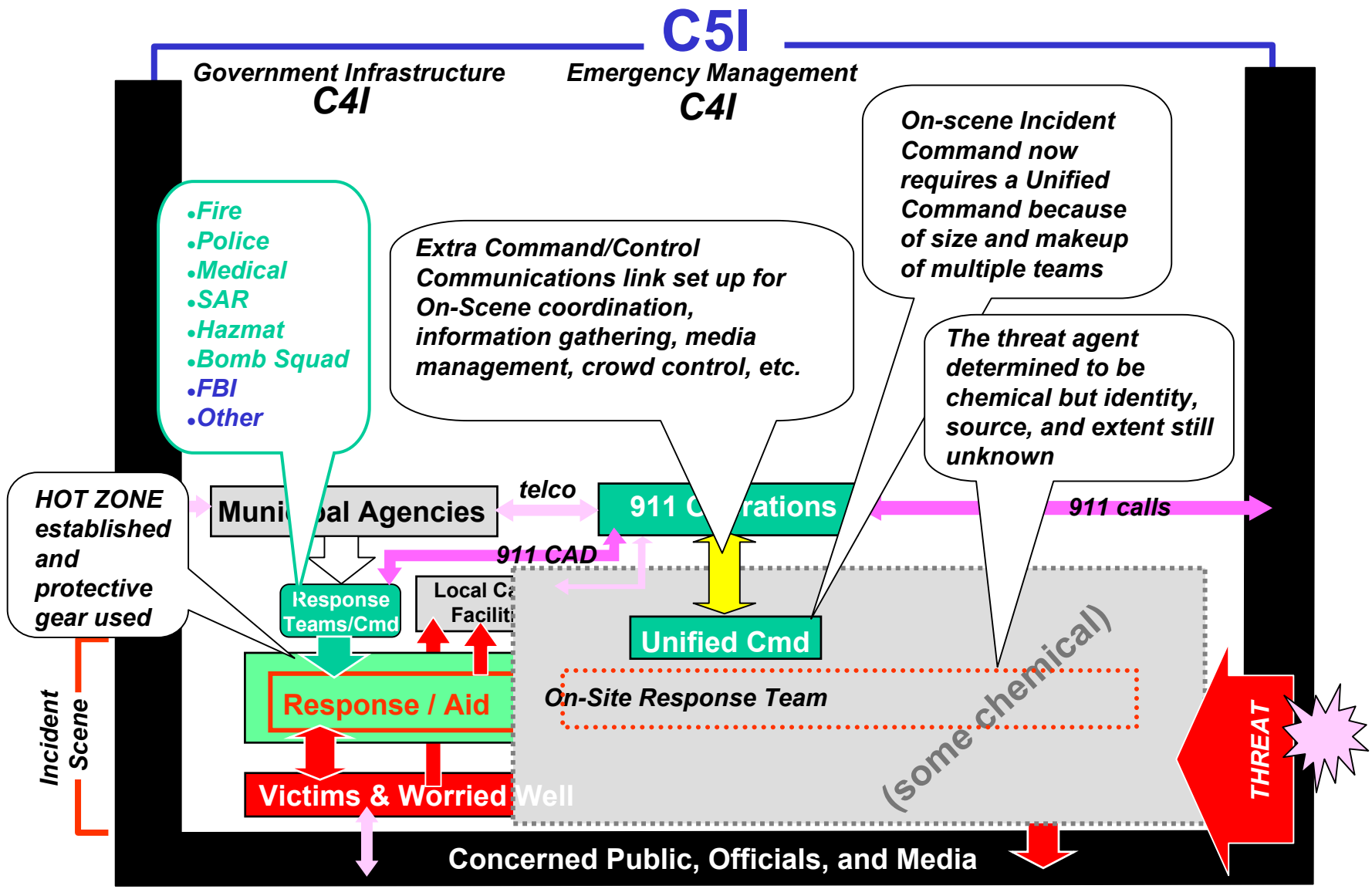
- Example where Everyday Incident Turns out to be a Chemical WMD Event Unfolding -



Modeling The Later-Beginning of a Chemical WMD Incident

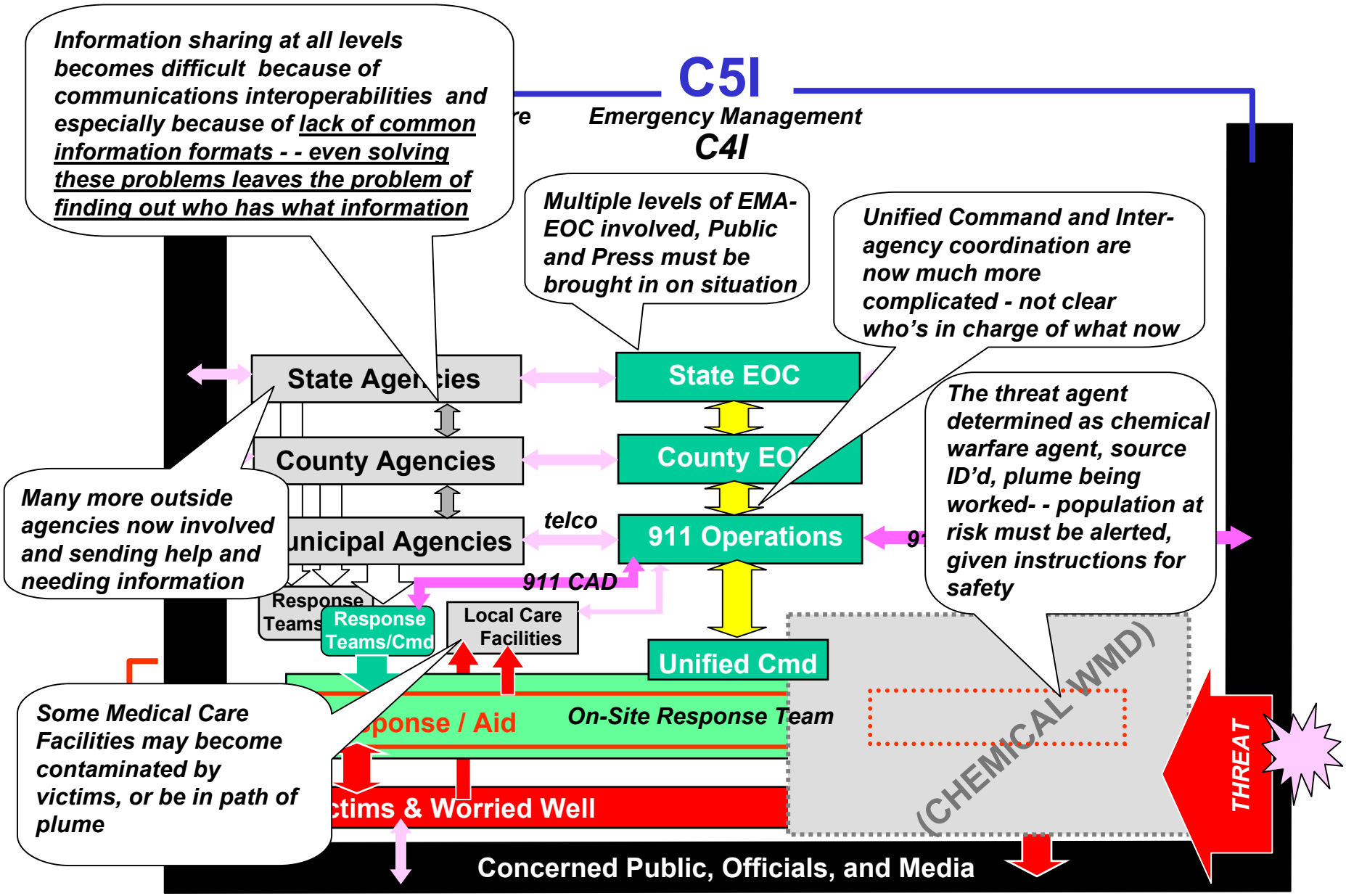
- More Responder Teams Are Called In, Situation Unfolding and Expanding -

-Cell Phones and E-911 may become overloaded and unusable-



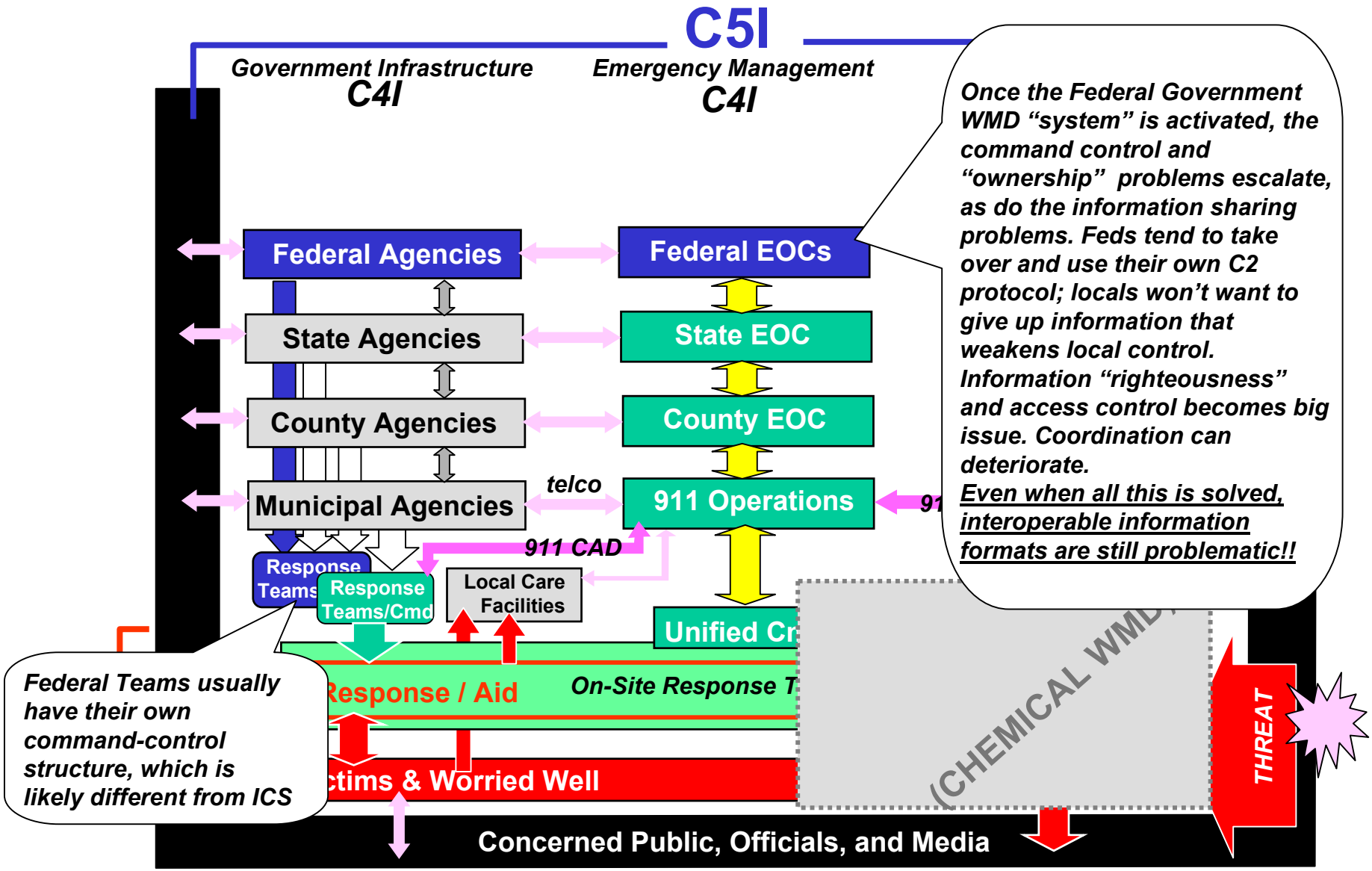
Modeling The Middle Stage of a Chemical WMD Incident

- Situation Beyond Local Abilities to Handle, Outsiders Called In (by who?) -



Modeling The "Federal" Phase of a Chemical WMD Incident

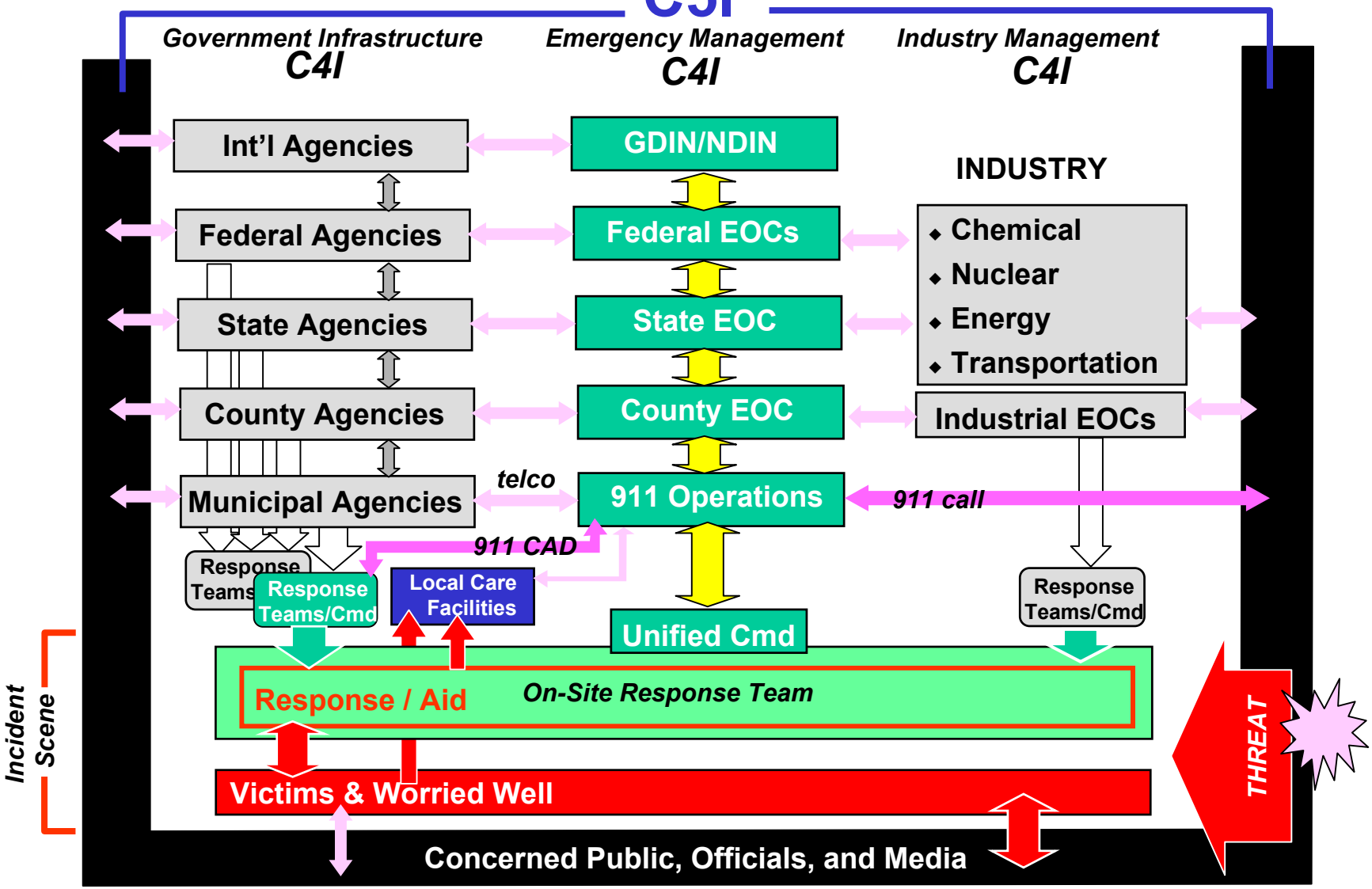
-Situation has Escalated to full-blown Federal WMD Incident-



Modeling The BIG PICTURE for Emergency Management

- Natural Disasters, Technological Disasters, Emerging Infectious Diseases, WMD Terrorism-

C4I + Information Coordination = C5I



Features of XII Information Interoperability Model

First Response
- Local
- Private

Second Response
- Mutual Aid
- State, NG

Third Response
- Federal

International Agencies

Government Agencies

State Agencies

Local Agencies

GDIN/NDIN EOCs

Government EOCs

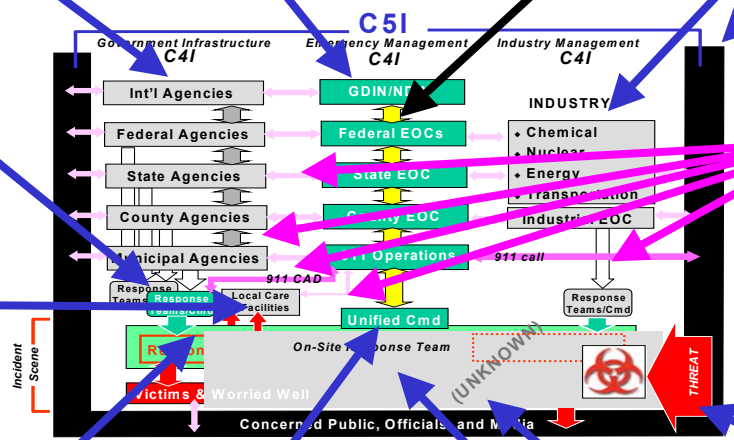
State EOCs

Local EOCs (911)

C2 Hierarchy and Data Ownership Chain

Industry EOCs

Public/Media



Interoperability Network Links and Information Protocols
- Special purpose
- Public/Private
- State & Local
- Federal
  - Civil & DoD

Inherited Response
- Hospitals
- Care centers
- Morgues

All Hazards Threat
- including extreme events

Response Teams Technologies
- Hazmat
- SAR
- Medical
- Biological/Chemical
- Radiological
- Explosives
- Fire
- Law Enforcement

Incident Command
- ICS (offsite-onsite)
- Special Commands
- Unified Command

Incident events, response situations, and victim's needs

On-Scene Incident data collection and derived information

(All items interrelated to Scenario event flow and timeline)

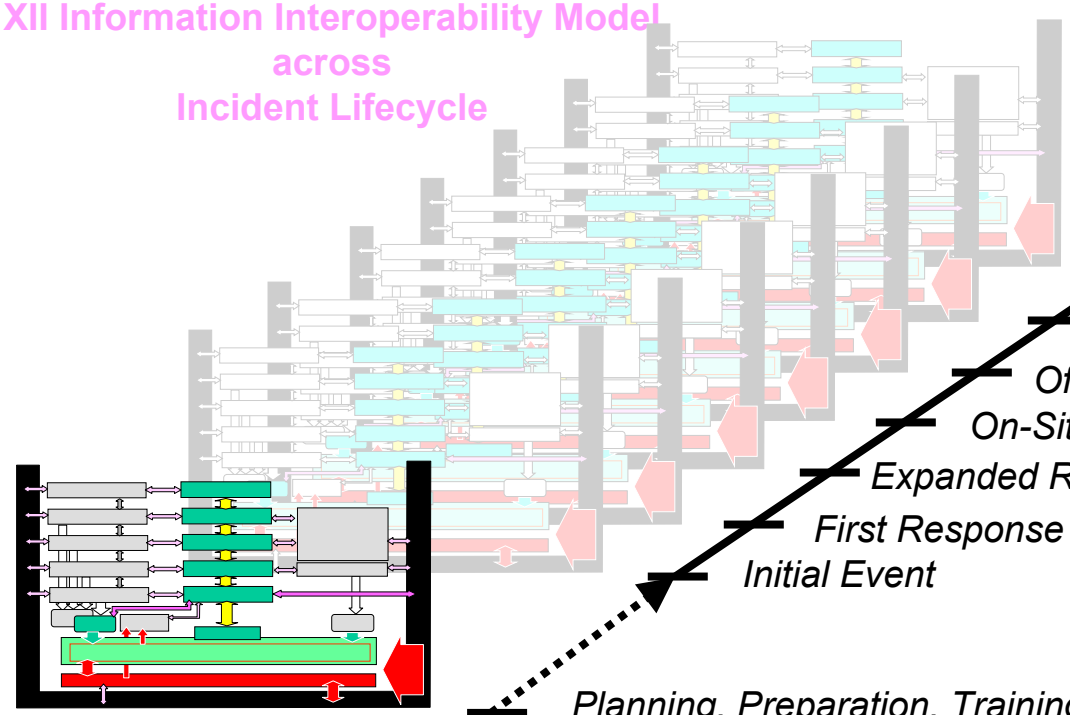
Extreme Information Infrastructure (XII)

The XII is an information infrastructure OVERLAY that allows cooperative interchange of information between all the different emergency management and response players from top to bottom and from side to side -- facilitating the exchange of the right information at the right time in the right place

- *Network connectivity is only a foundation*
  - *nodes and links provide connectivity and accessibility, throughput capacity*
  - *networked services provide security, reliability, graceful degradation, information delivery confirmation, data archiving*
- *Common message formatting necessary to facilitate information interchange*
  - *In absence of common formatting, information translators can be used*
- *Creation of common, shared, incident knowledge base is dependent upon data-fusion activity*
  - *Intelligent Information search-agents are required to acquire data for data fusion*
- *Information ownership, access controls, data righteousness are totally separate issues*

XII Interoperability Model Across Incident Lifecycle Timeline

XII Information Interoperability Model
across
Incident Lifecycle



Incident Lifecycle Timeline

Reconstitution
Resolution
Off-Site Medical Care
On-Site Medical Care
Expanded Responses
First Response
Initial Event
Planning, Preparation, Training, Exercise

Basic Incident Types

- **E-911**
- **Hazmat**
- **Expanded E-911**
- **Mutual Aid**
- **Natural Disaster**
- **Explosives Terrorism**
- **Chemical Terrorism**
- **Biological Terrorism**
- **Emerging Infectious Disease**
- **Radiological Terrorism**
- **Nuclear Terrorism**

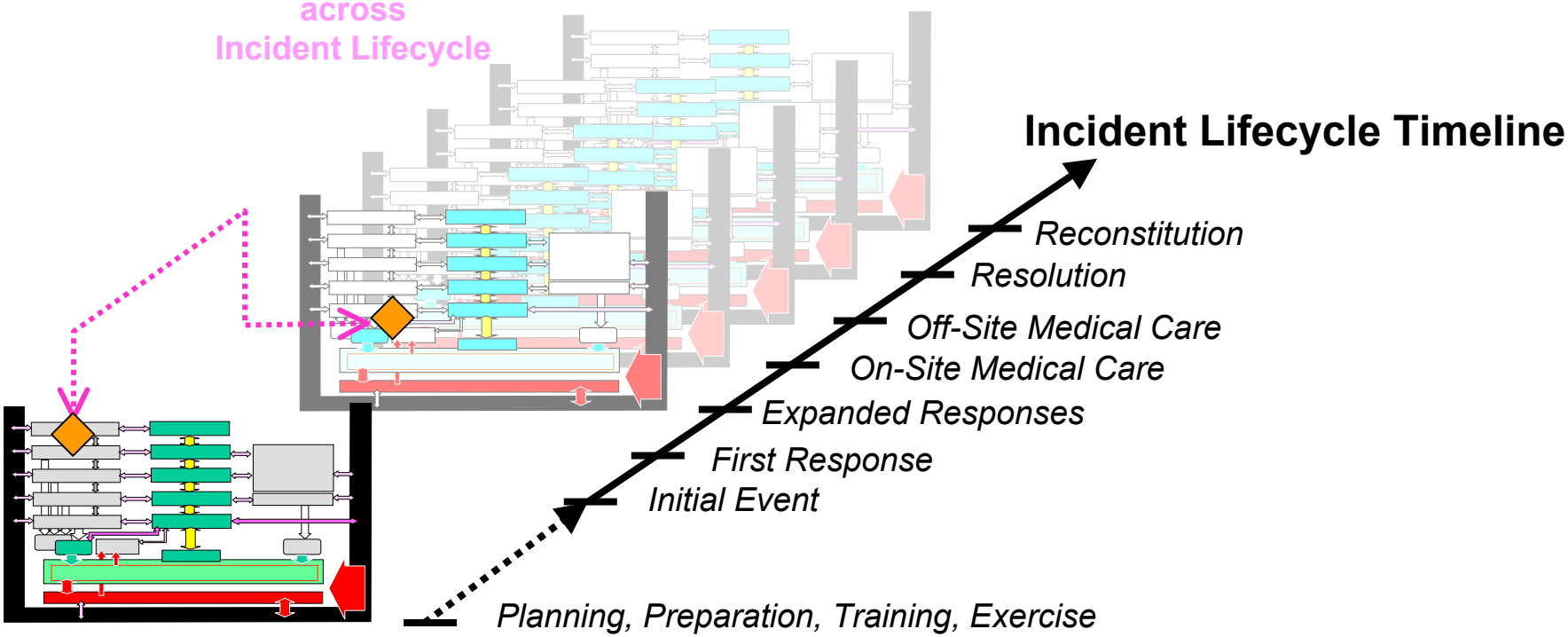
Why Do We Need and Information Model?

- To facilitate the exchange of the right information, at the right time, in the right place . . .

- Which requires knowing what information is needed, when, and where, and why . . .

- Which requires and information model across events, time, organizations, and users . . .

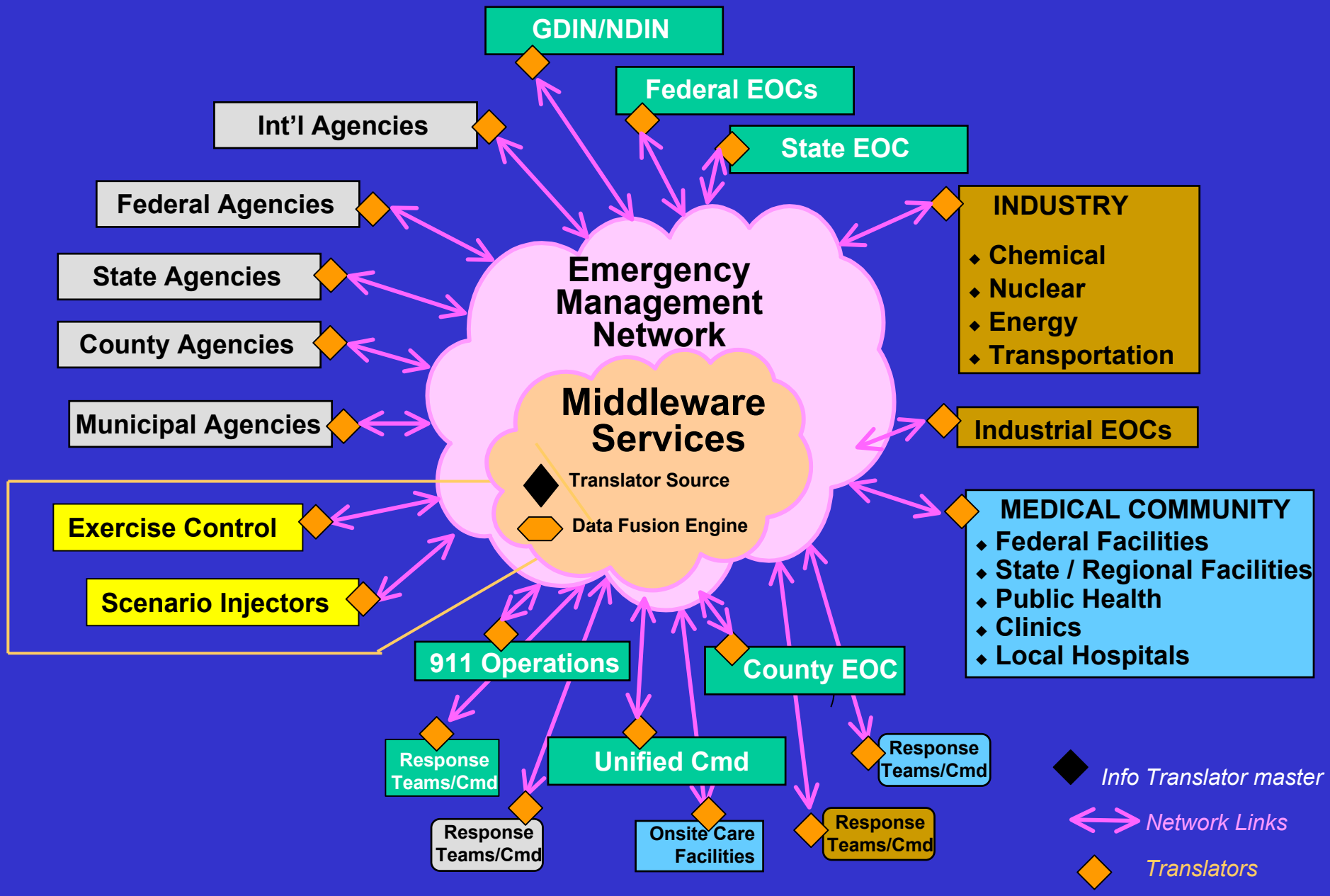
XII Interoperability Translator Example



XII Information Translator Example for GIS

A very simple example of the use of an XII information translator is when a Federal Response Team arrives on site for assistance and needs to use some detailed GIS mapping information. The local GIS detailed maps prepared by and owned State or Municipality resources may be in a format different than that used by the Federal Team. A translator is needed so the Federal Team can use the local detailed maps, and then add and share incident specific knowledge with other incident participants.

Net-Centric View of the "XII System"



Summary of XII Net-Centric Requirements

Five Key Requirements for Emergency-Incident Knowledge Exchange

1) Communications Interconnect Accessibility

- Requires compatible network links and protocols

2) Data Accessibility

- Requires access privilege (includes need-to-know), identity verification, common directory, intelligent search agents (these require knowledge to work well), and data interoperability

3) Data Interoperability

- Requires compatible data exchange formats or translators

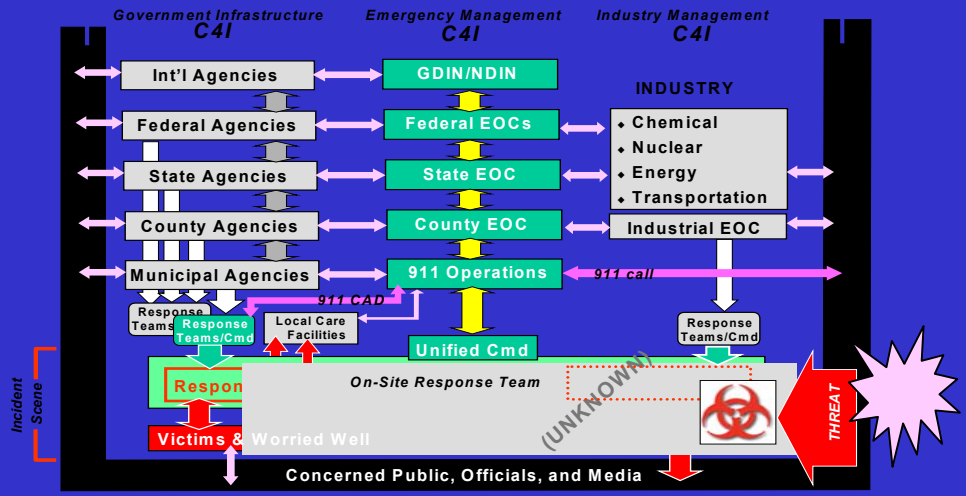
4) Information Sharing

- Requires common data context, which means common information formats or templates, and common glossary

5) Knowledge Sharing

- Requires that all event, time, and space relationships between information parcels be referred to a common operational model having end-to-end, top-to-bottom, side-to-side, and front-to-back interactions defined with common symbology, glossary, format.

Why is the XII Model Needed?



- The XII Information Model is can help understand what kinds of information are needed at what places and what times for what purpose, in order to build a "smart" directory and knowledge agents for decision support, and to define the common incident "picture" components and format.
- It can also be used to track the evolution of command protocol as the situation progresses from strictly local to national catastrophic medical disaster.
- It can be used to establish a foundation for modeling and simulation work, leading to capabilities for a national simulation capability for catastrophic medical emergencies.

National Institute of Urban Search & Rescue

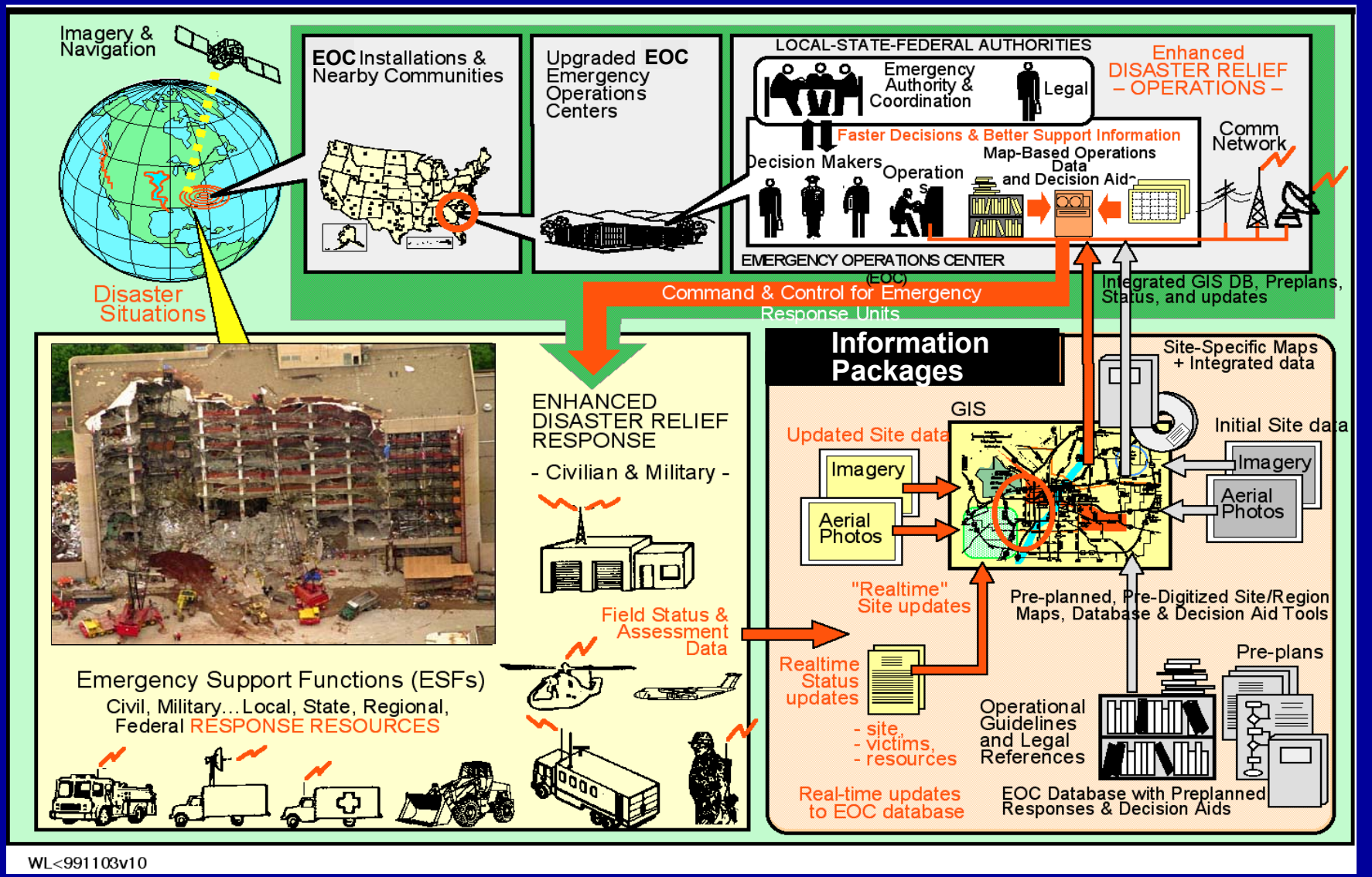
The NIUSR High Level Reference Model for Disaster Management

B. L. Hartway

Requirements Chairman, NIUSR

June 14, 2001

Operational Concept Model for Emergency Response



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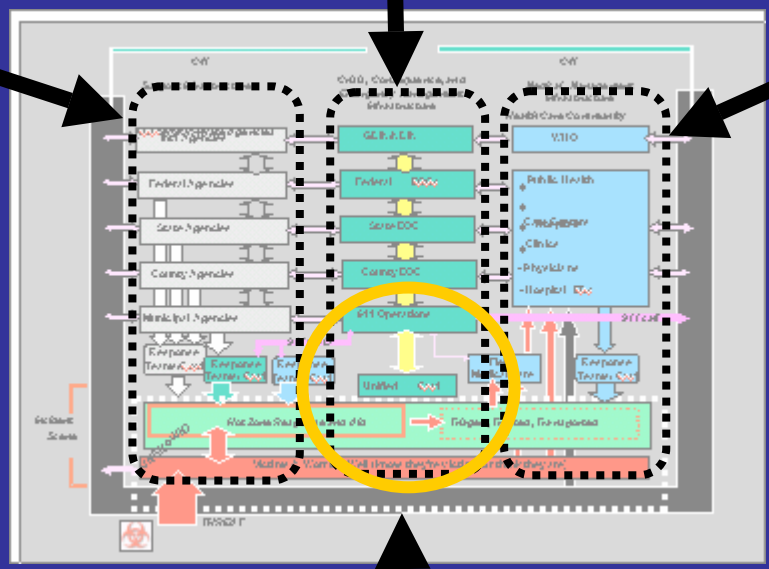
The updated NIUSR High Level Reference Model (HLRM)

- Showing the many faces of “Emergency Management”

All Hazards Emergency Management C6I

Disaster Emergency Management

Support Agencies

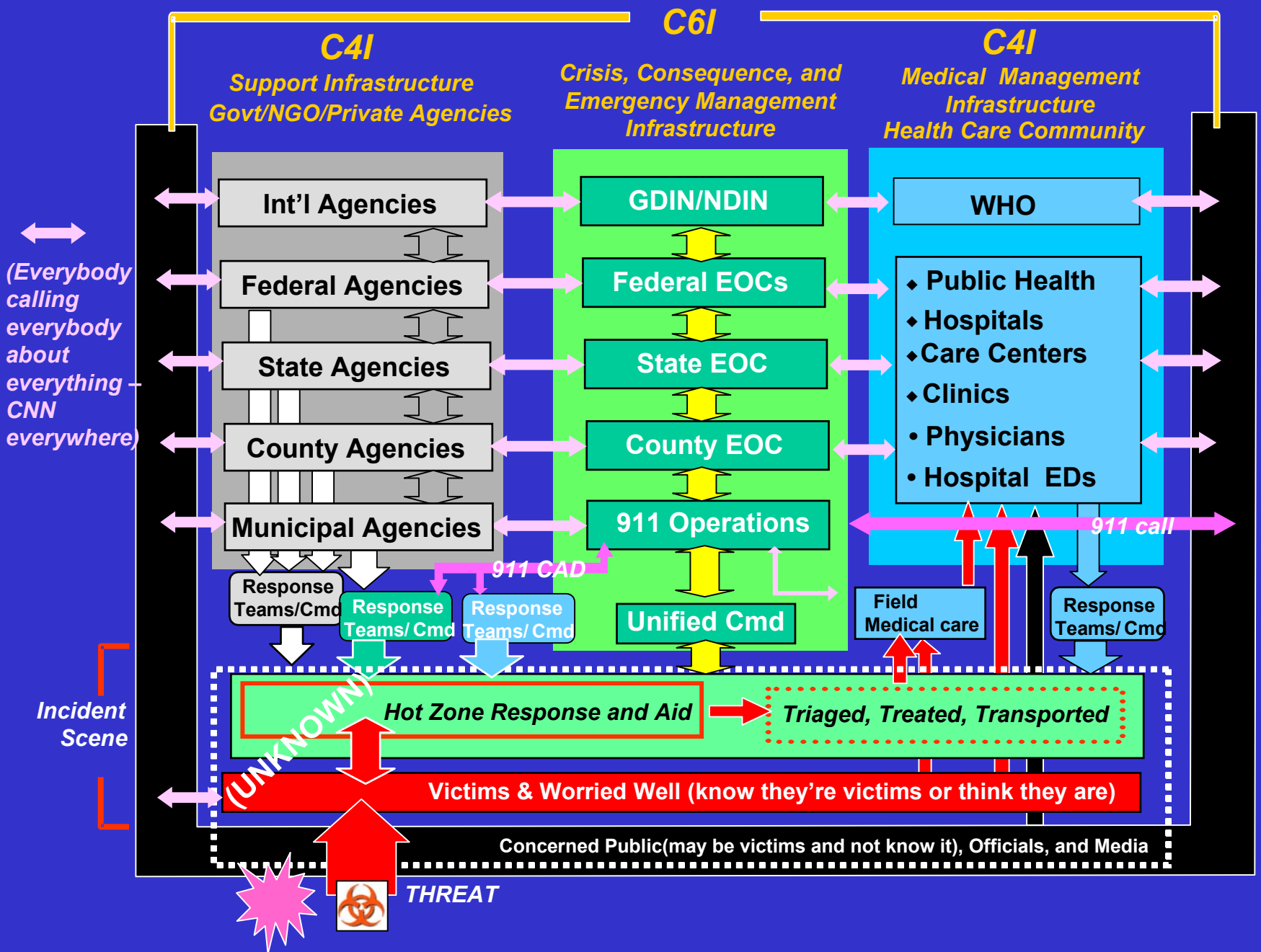


Catastrophic Medical Disaster Emergency Management

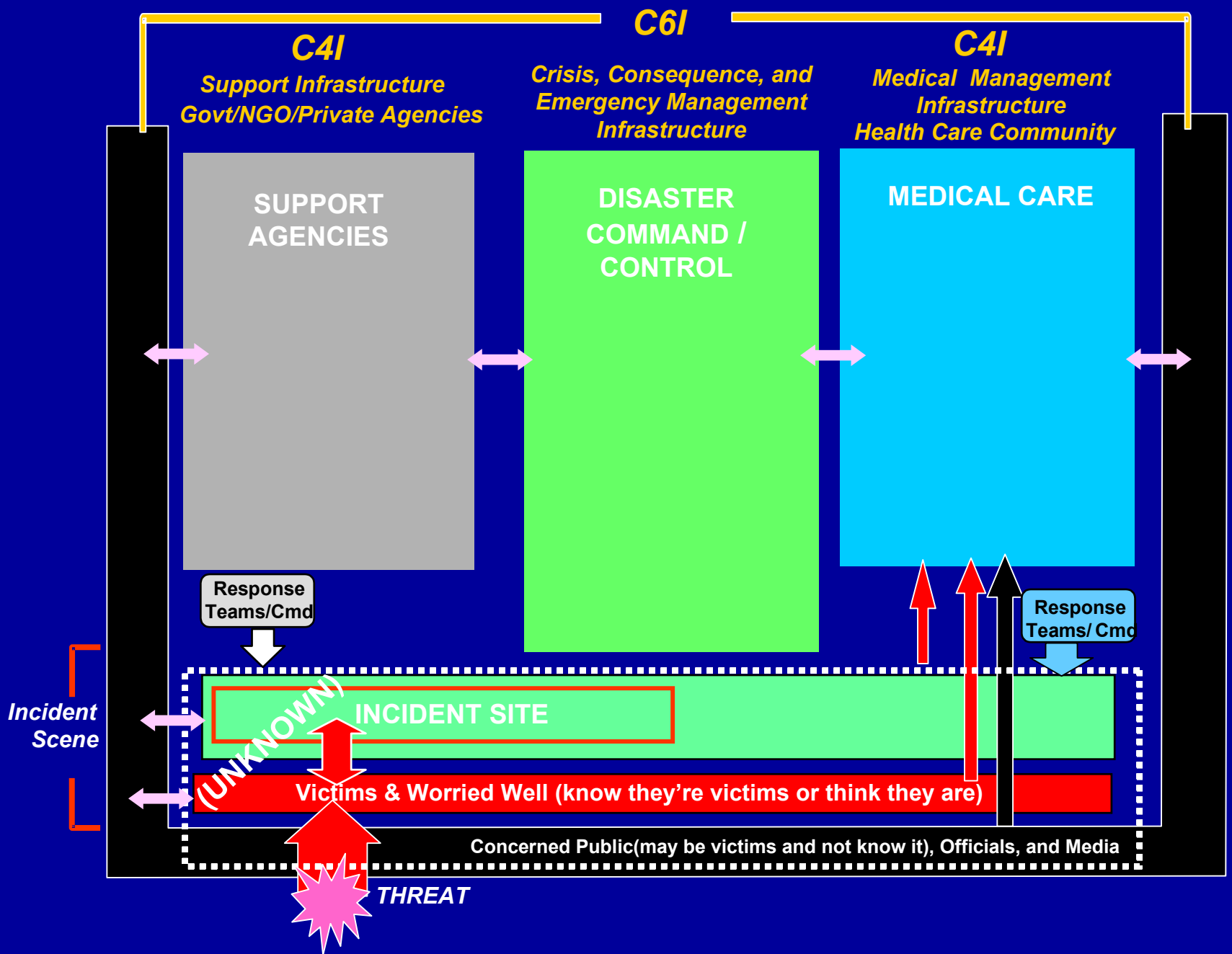
Public Safety (First Responder) Emergency Management

C6I = C4I + Multi-Agency Cooperation and Coordination

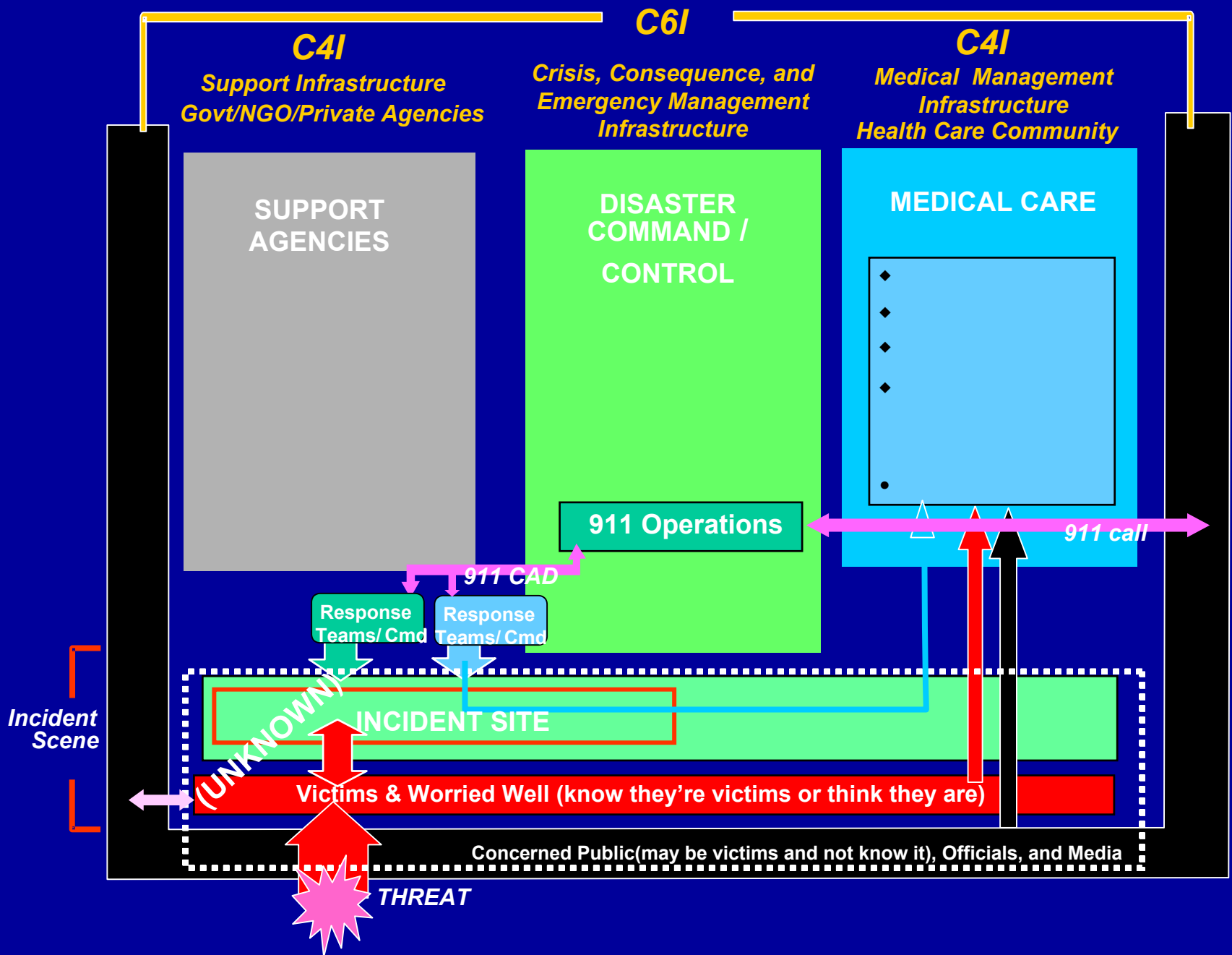
The updated NIUSR High Level Reference Model (HLRM)



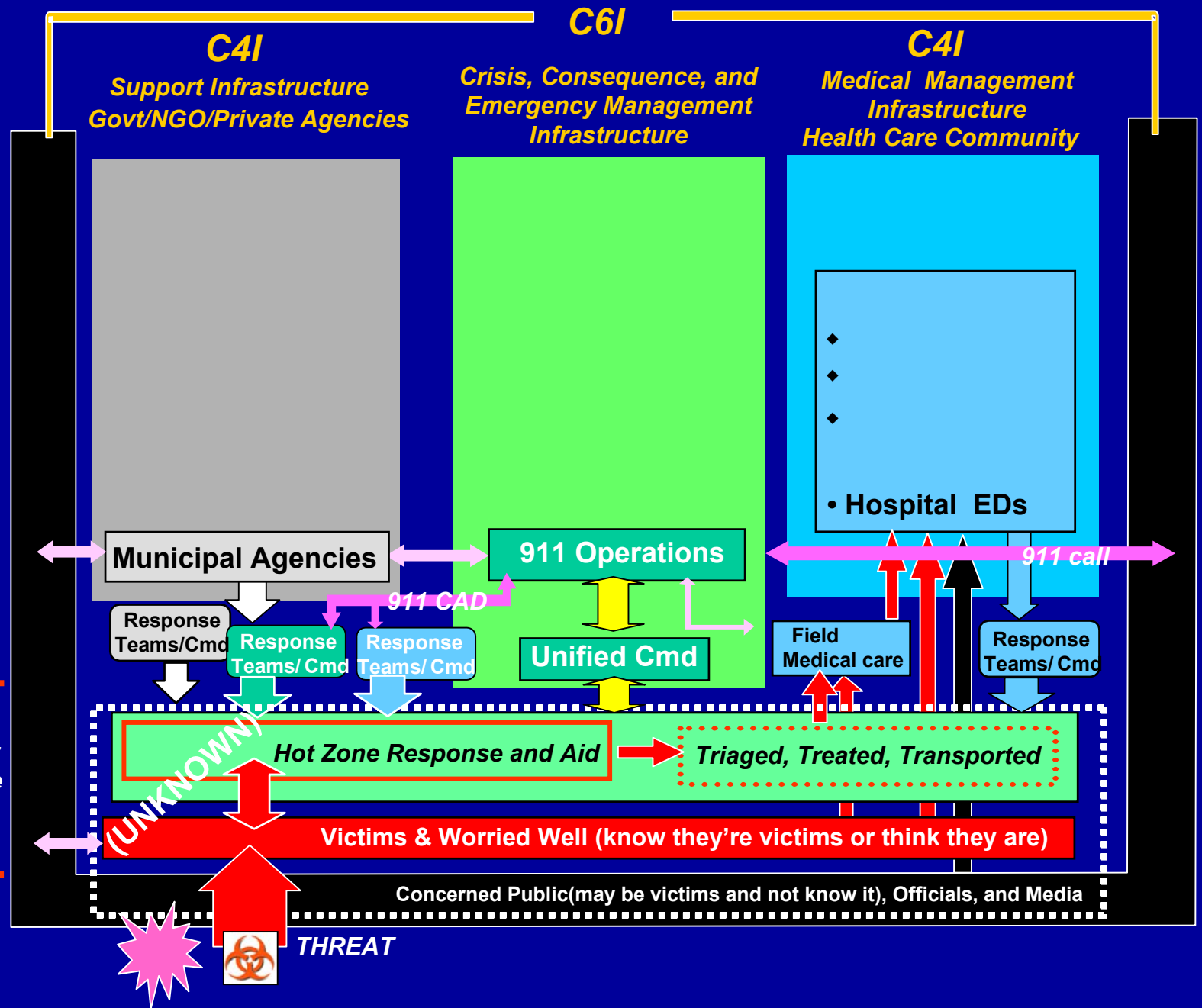
Basic HLRM Model "Foundation"



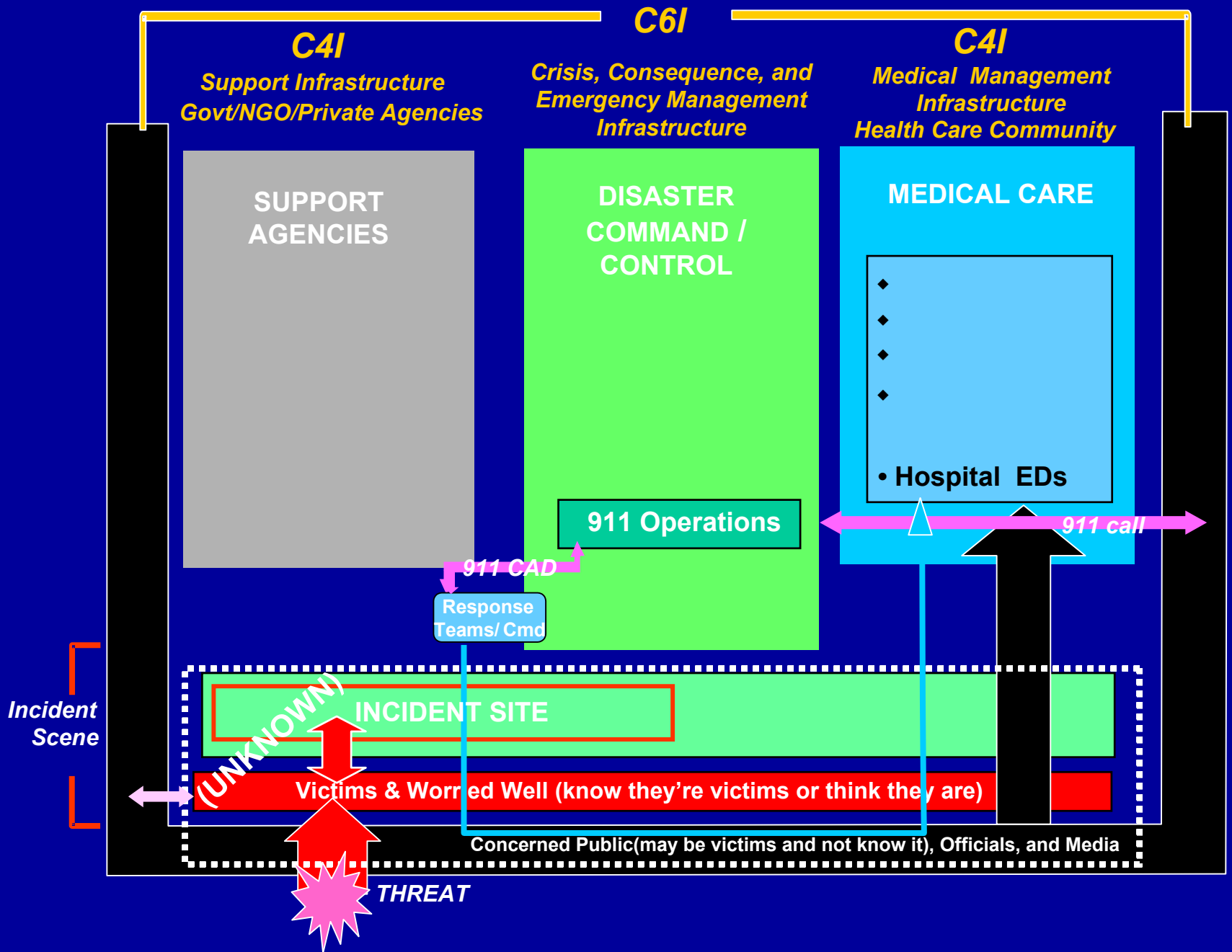
HLRM Model for Simple 911 (or the beginning of WMD?)



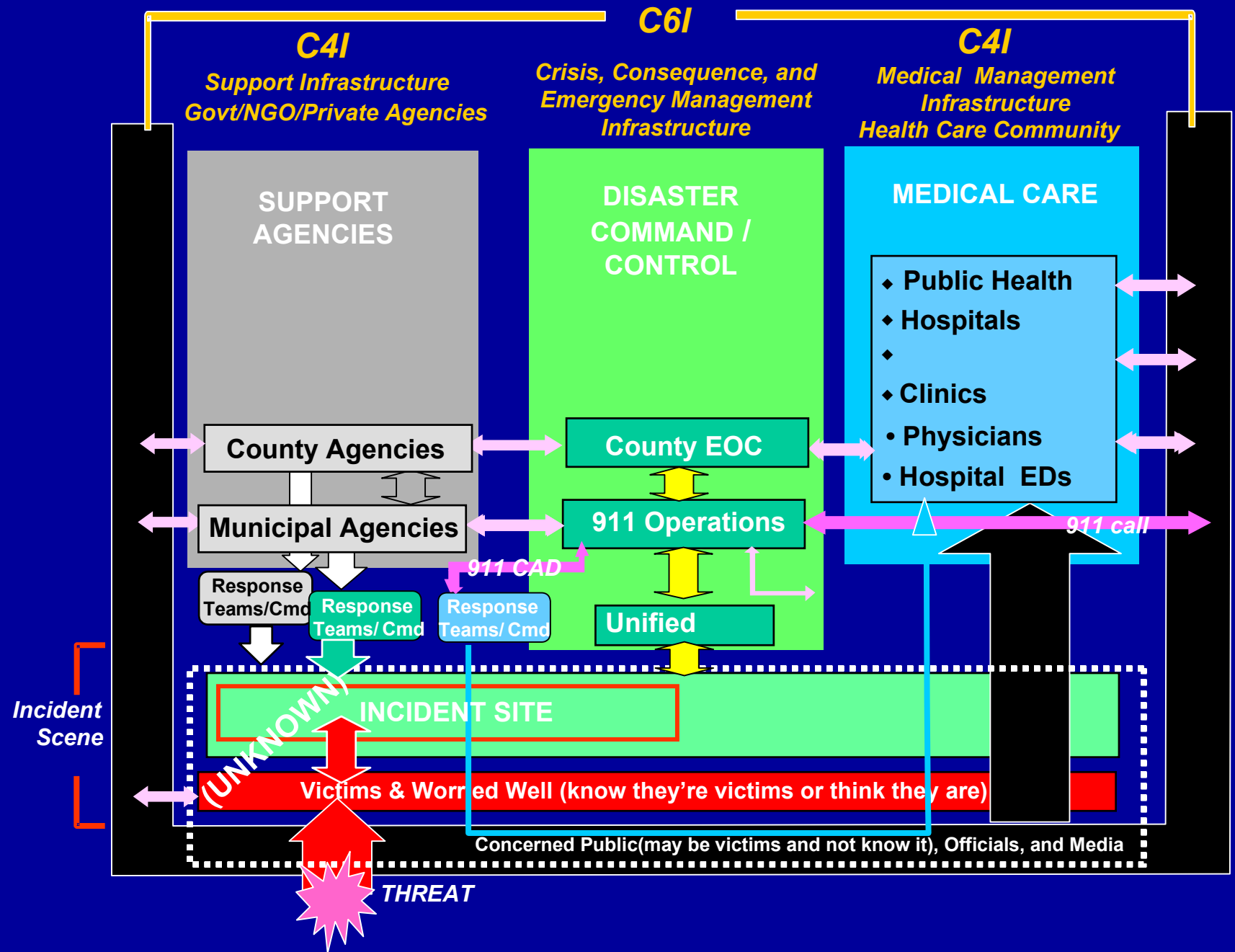
An Expanded On-Site Casualty Situation (Mutual-Aid)



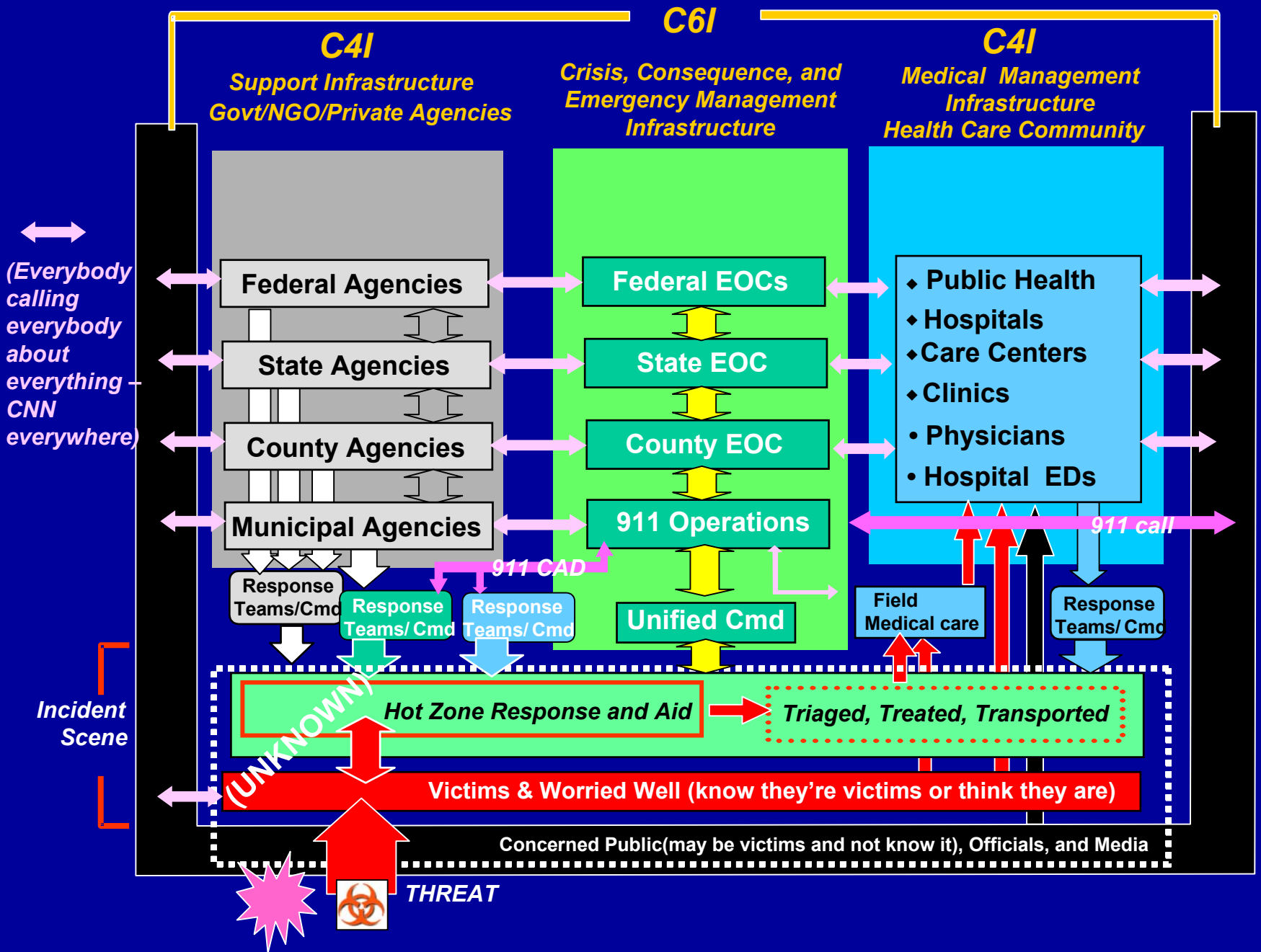
Model for Beginnings of (Unrecognized) Covert Bio-Event



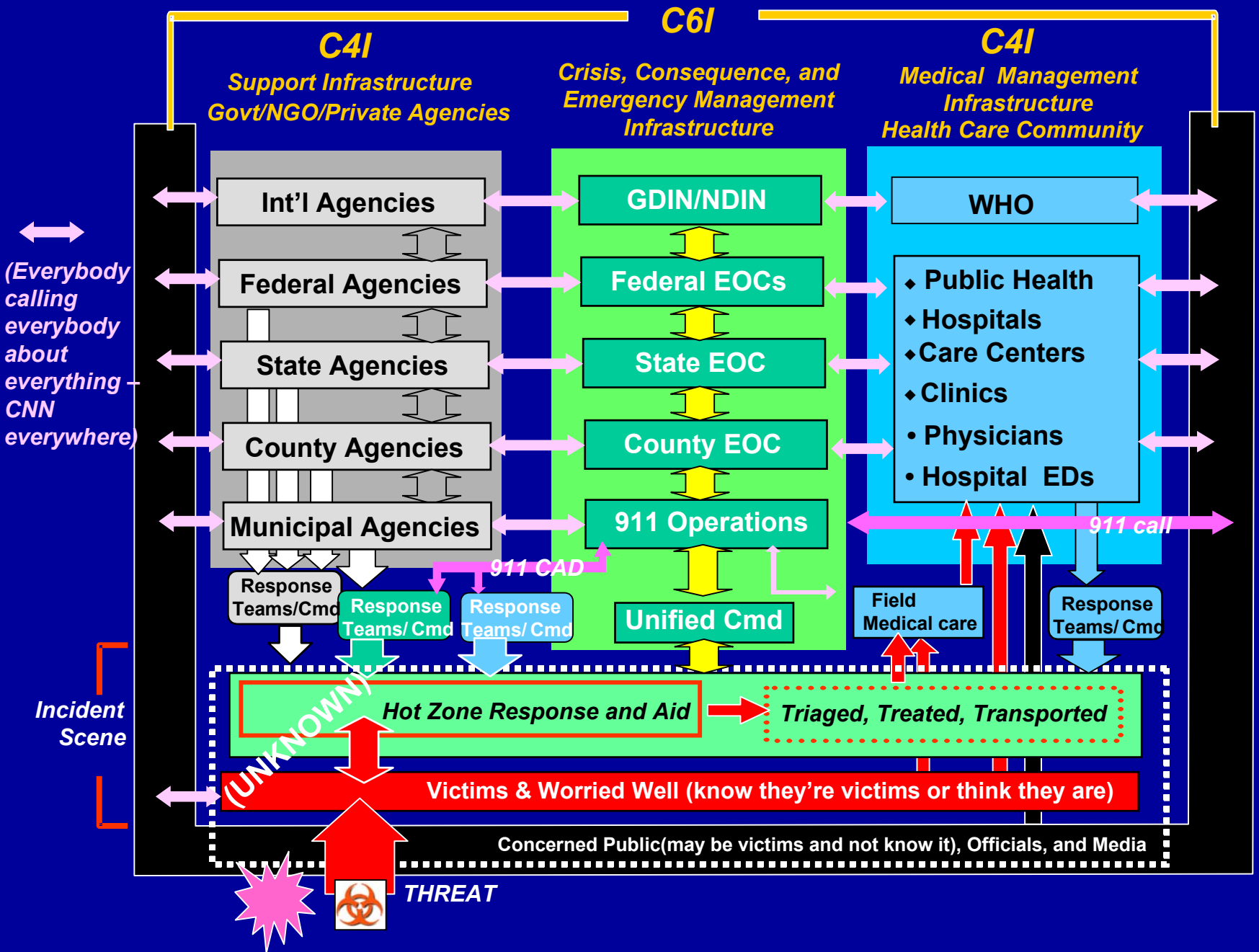
Bio-Situation Recognized as Some Kind of Perpetrated Event



A "Homeland Defense" Situation for a Recognized Attack



The updated NIUSR High Level Reference Model (HLRM)



National Institute of Urban Search & Rescue

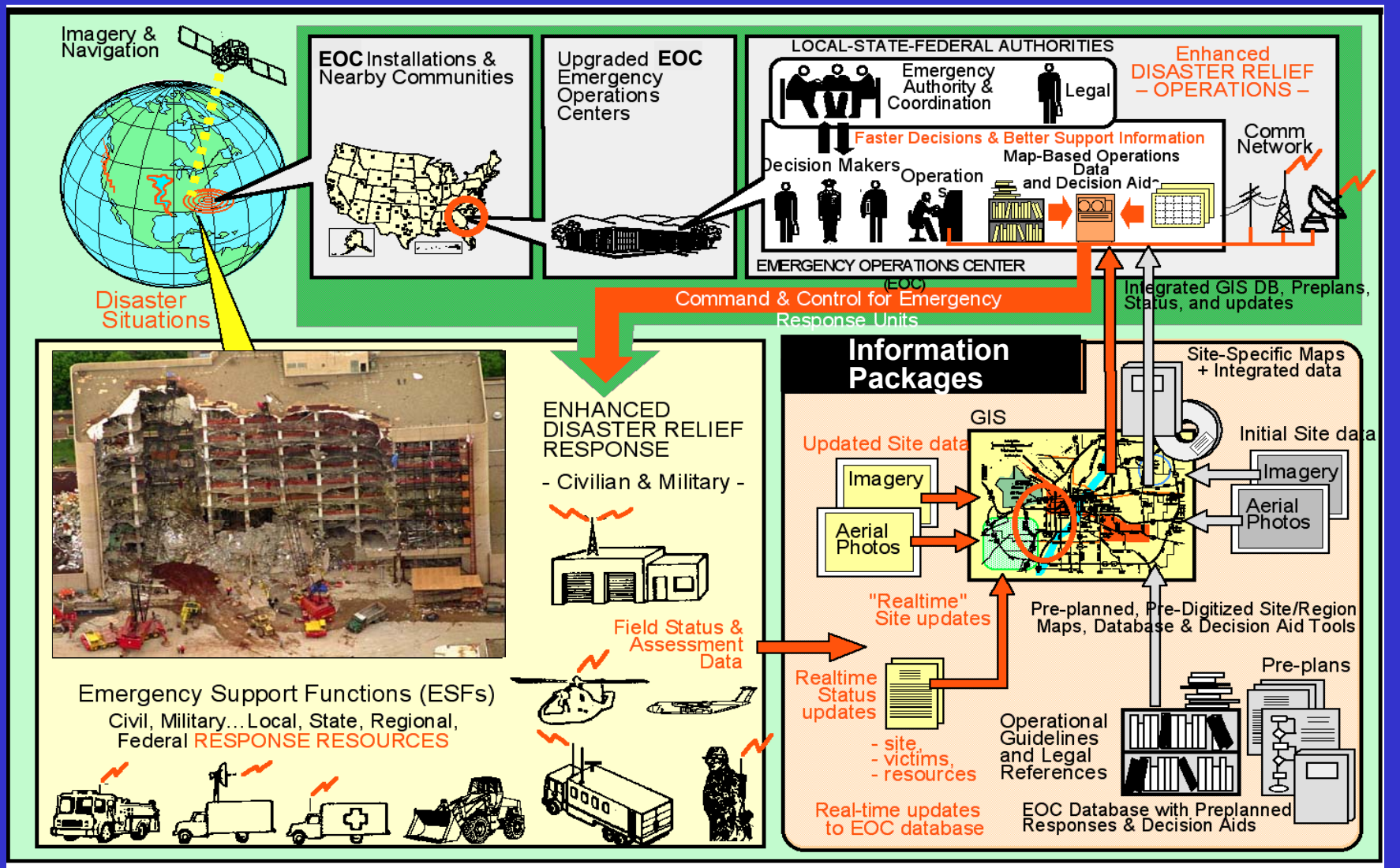
Technical Aspects of NIUSR High Level Reference Model

B. L. Hartway

Requirements Chairman, NIUSR

June 14, 2001

Operational Concept Model for Emergency Response



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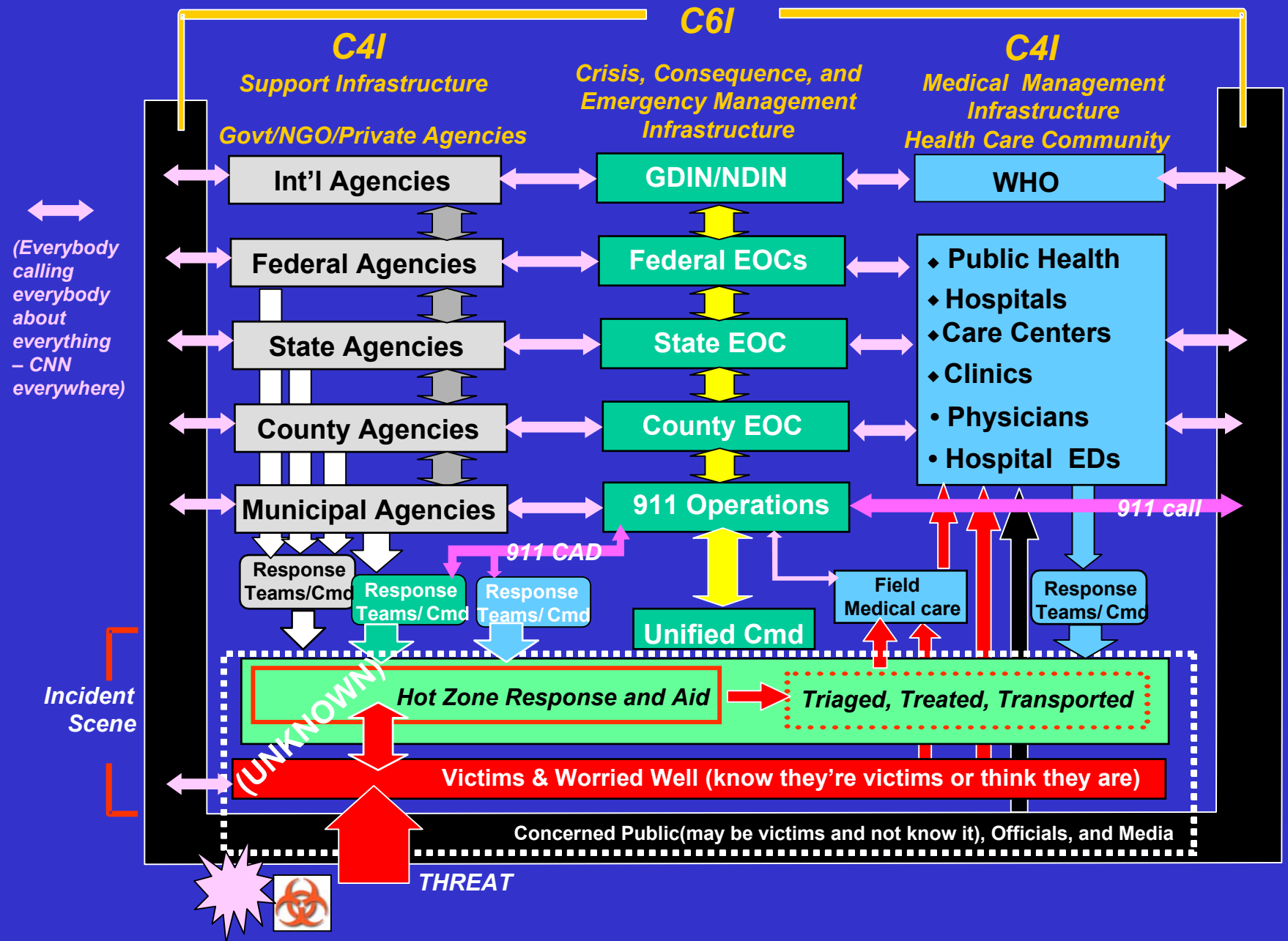
The updated NIUSR High Level Reference Model (HLRM)



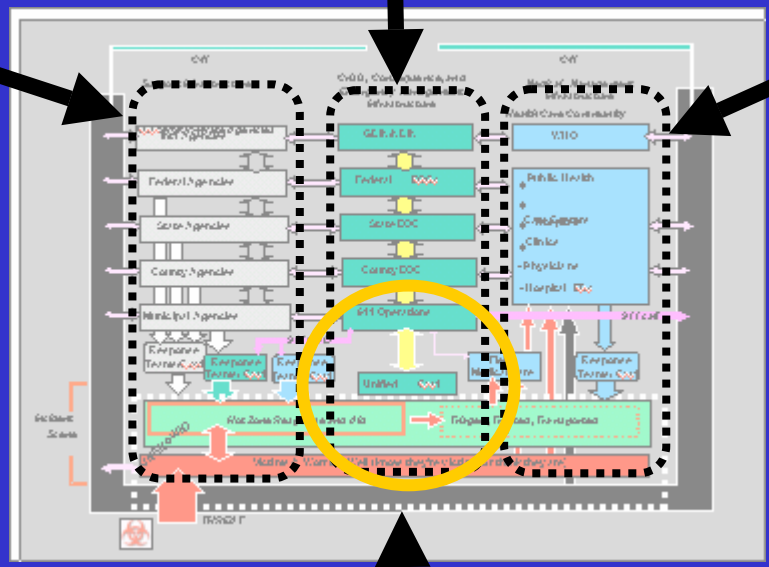
The updated NIUSR High Level Reference Model (HLRM)

- Showing the many faces of "Emergency Management"

All Hazards Emergency Management C6I

Disaster Emergency Management

Support Agencies



Catastrophic Medical Disaster Emergency Management

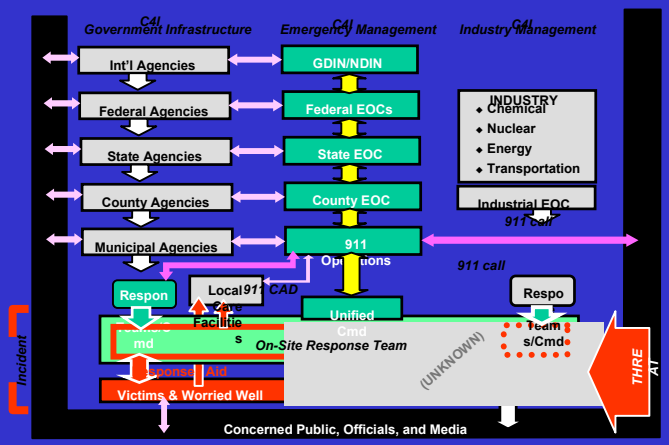
Public Safety (First Responder) Emergency Management

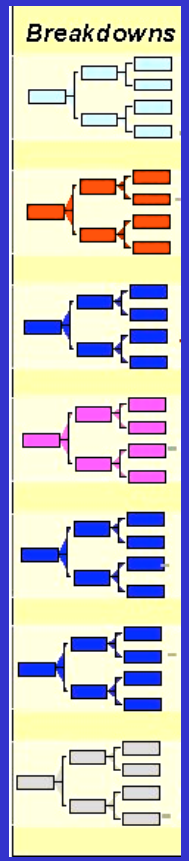
C6I = C4I + Multi-Agency Cooperation and Coordination

Top Down Requirements Analysis
Using the High Level Reference Model

- Sometimes called Domain Analysis -

Each Element Category of the HLRM can be decomposed into hierarchical structures





Weather or Environment (E)

Threat Conditions & Agents (T)

Detection and Sensing (S)

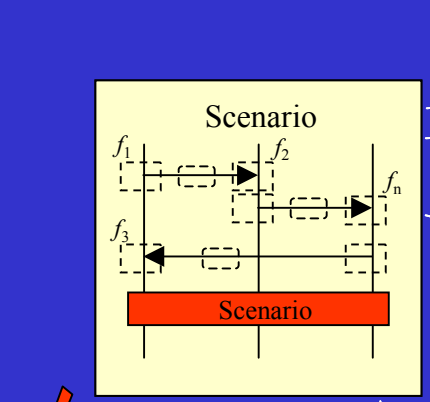
Communications (C)

Command Control (C2)

Intervention / Response (I)

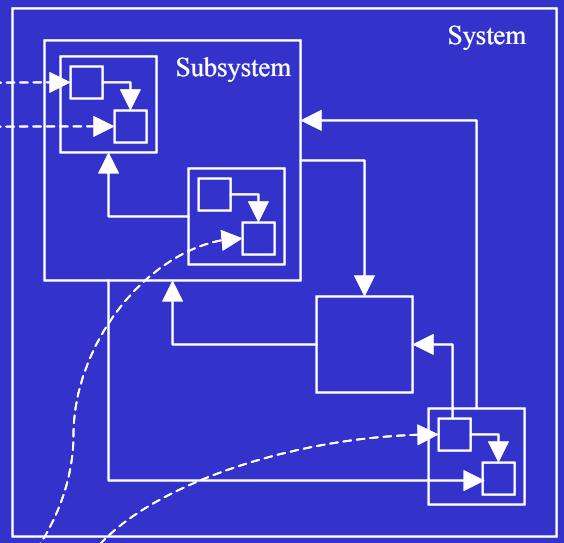
Supporting Agency Interfaces (IF)

Scenario/System-Model Driven Analysis Approach



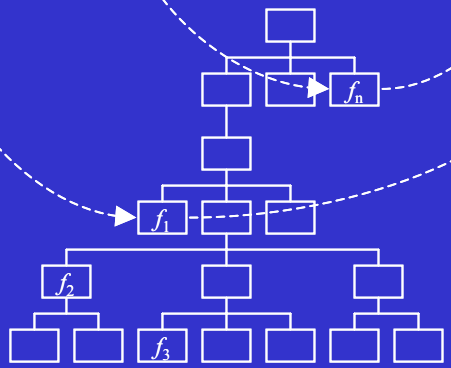
✓ **Operational Scenarios and Actions**

Traceability of relationships



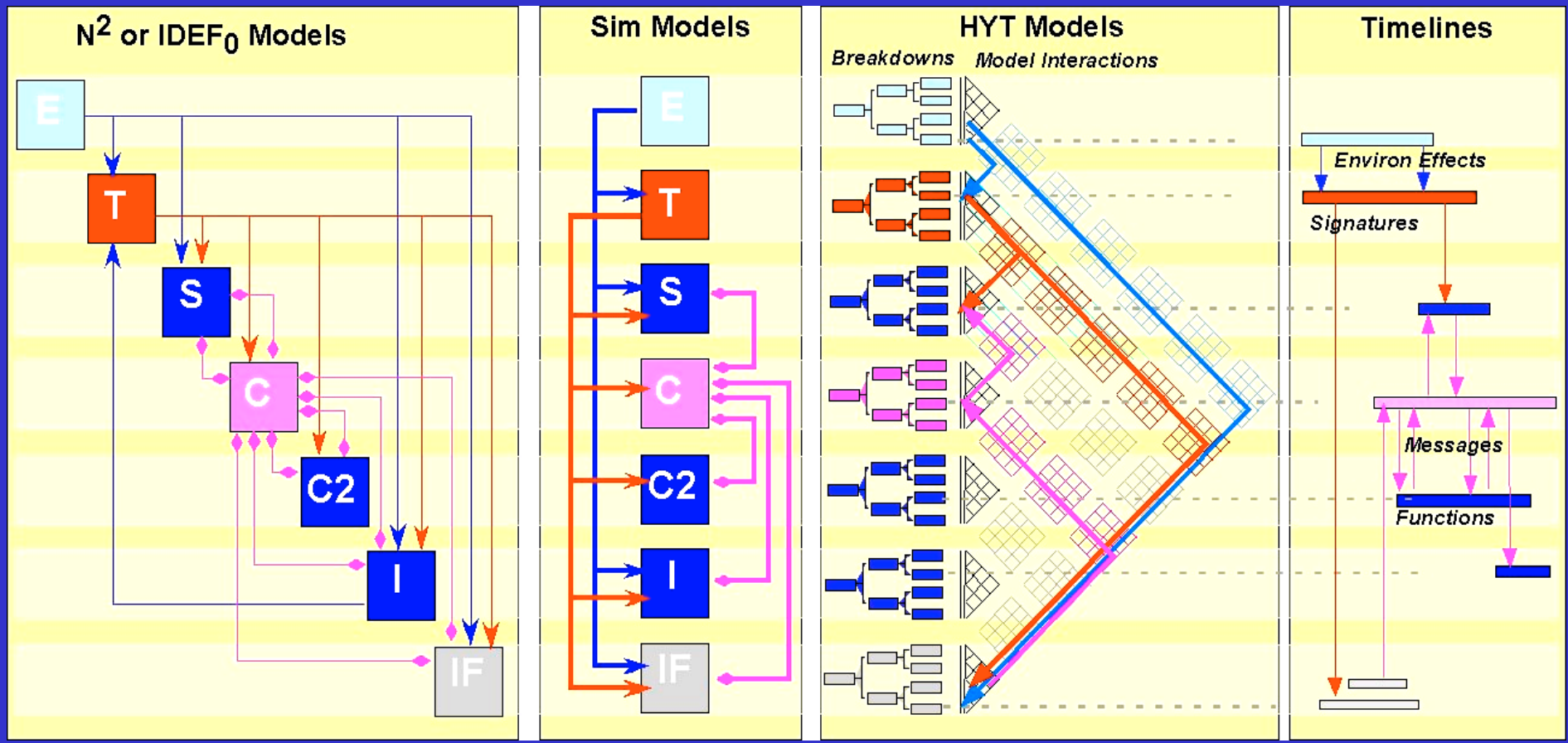
Entity Interactions and Operations

The victim's needs are the key response drivers



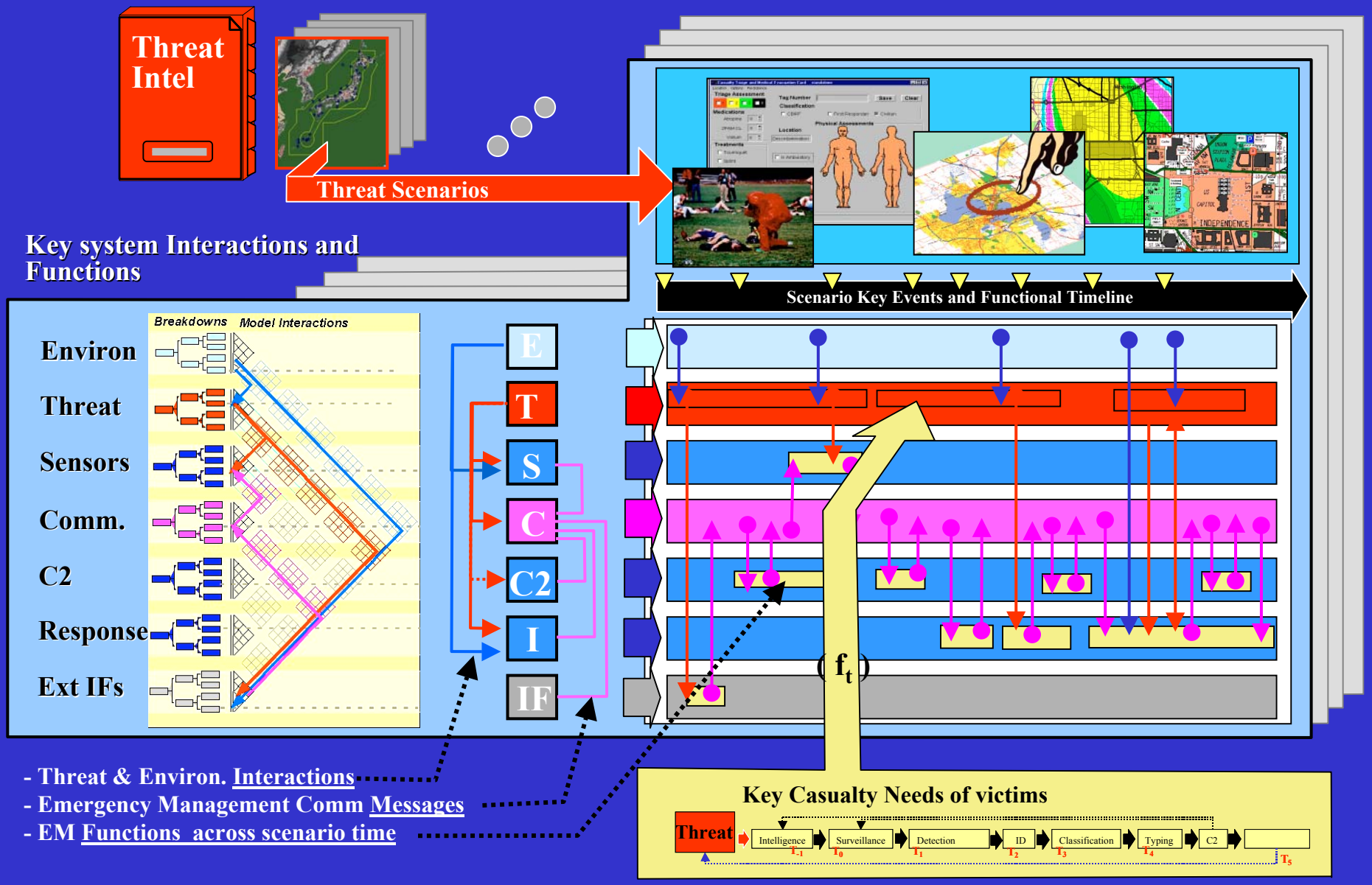
System Entity Decompositions

There are many equivalent representations of the interactions between system entities

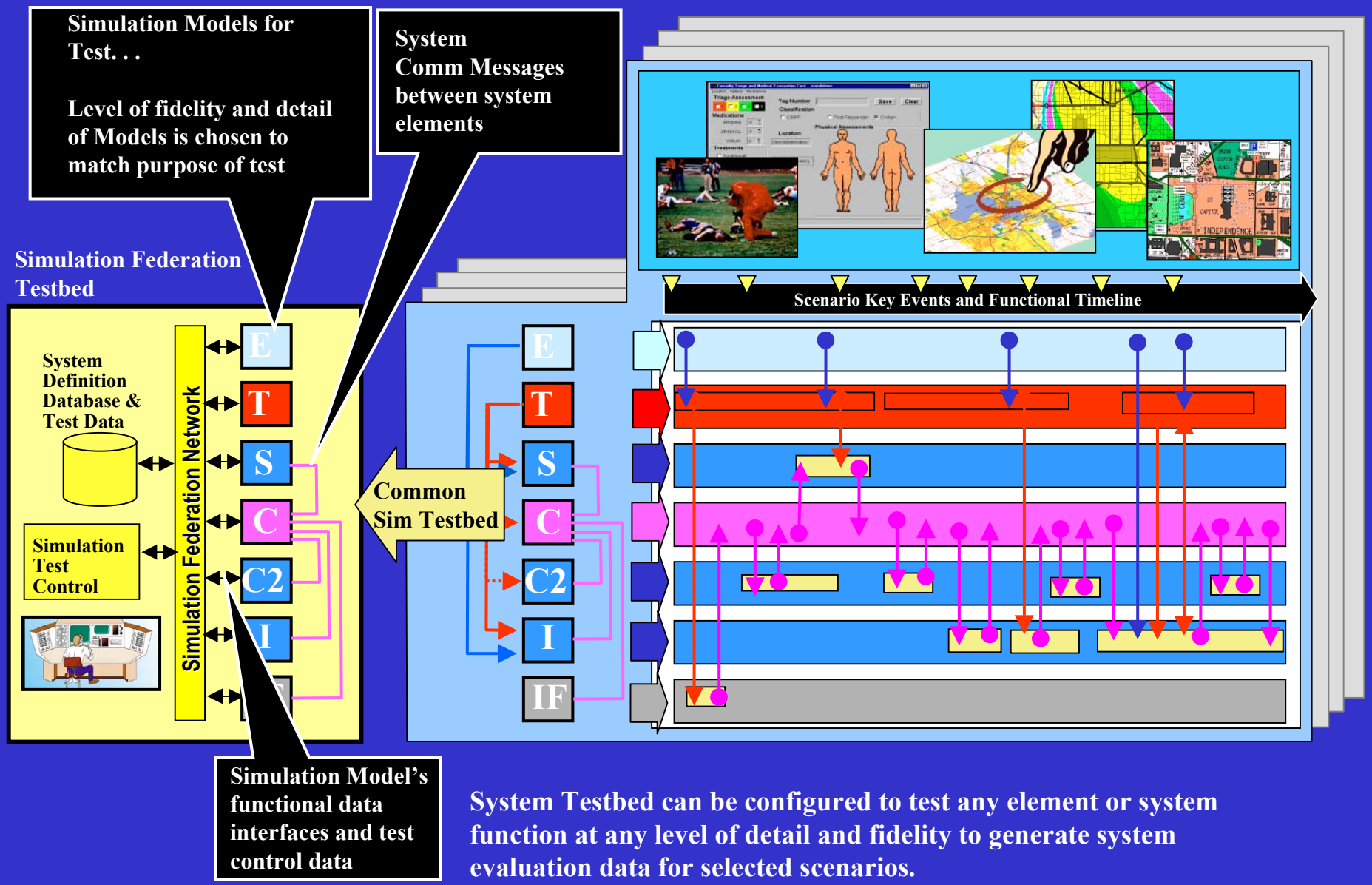


The HYT paradigm structured interaction chart is a universal basis tool supporting all representations

Interplay of Scenario Events, Timing, and Functions Across Scenario Event Space



Simulation Test Bed Supports Analyses for All Scenarios



System Testbed can be configured to test any element or system function at any level of detail and fidelity to generate system evaluation data for selected scenarios.

Emergency Management Consequence Timelines

INCIDENTS

Super Terrorism
- Chemical
- Biological
- Nuclear
- Radiological

Natural Disasters
- Flood
- Earthquake
- Hurricane
- Tornado

Criminal Terrorism
- Explosives

Everyday Life
- Accidents

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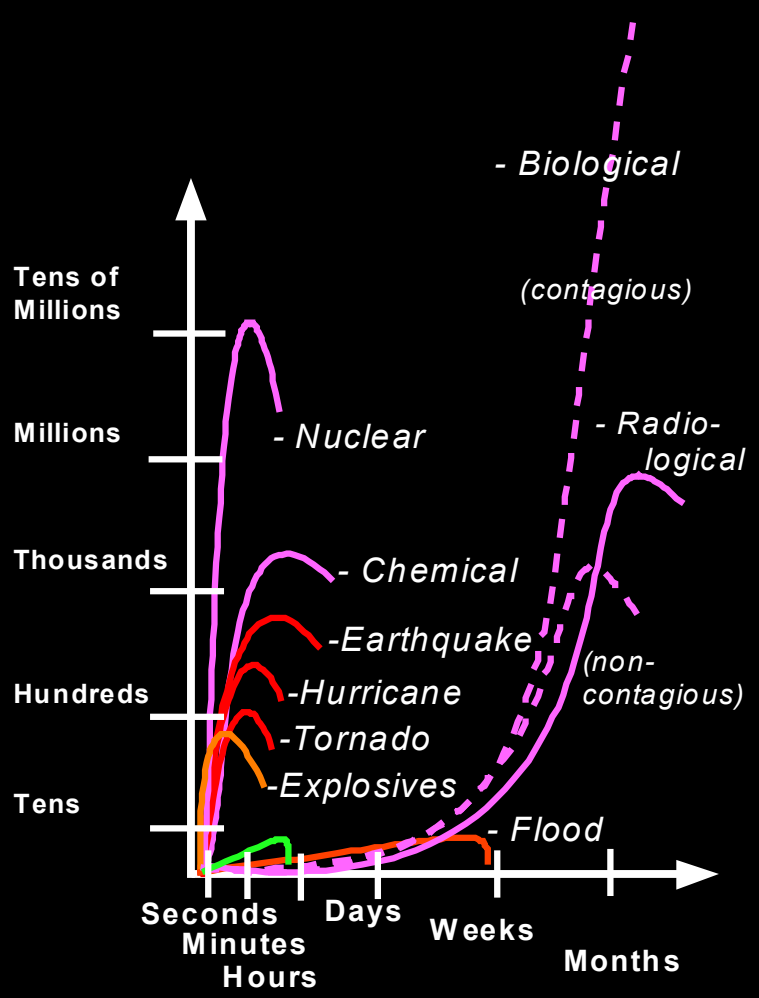
POTENTIAL CASUALTIES



RESPONSES

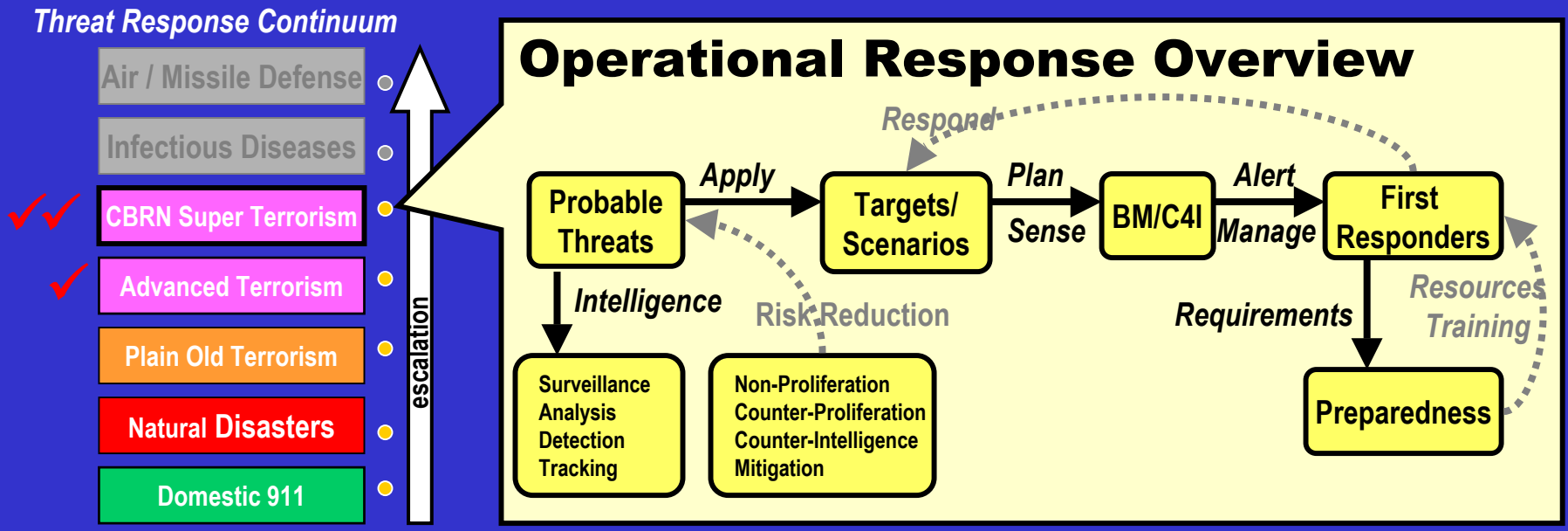
Warfare Type Ops
- Evacuation
- Containment
- Decontamination
- Quarantine
- Vaccination
- Antidotes
- Detoxification

State-Fed Escalation
- Search & Rescue
- Sustainment
- Medical Triage
- Temp Morgue

Escalation
- Bomb Squad

First Response
- First Aid
- Rescue
- Fire
- Police

Counter terrorism Operations Overview

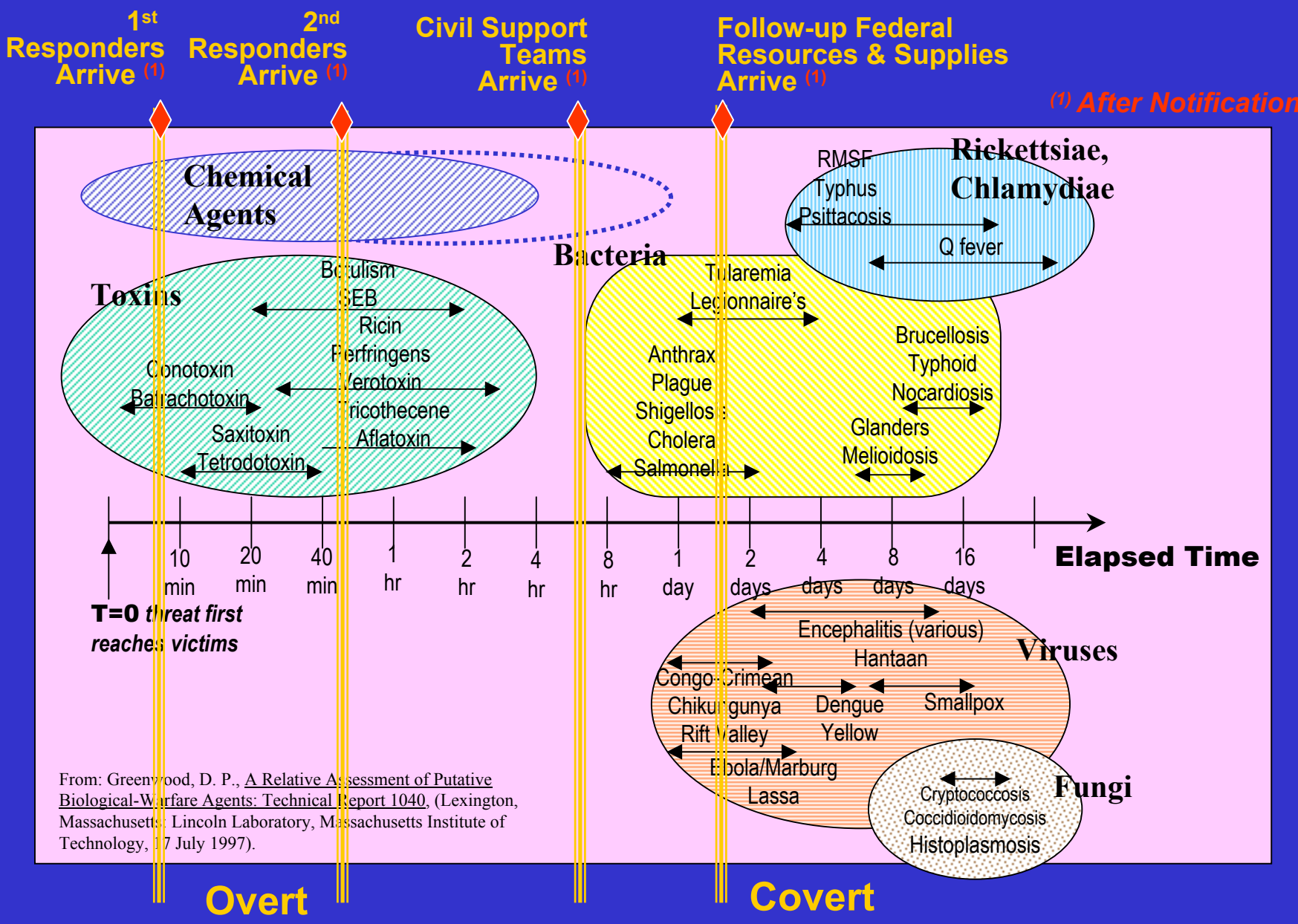


- Basic Operational Functions are the same for all types of incidents
  - *but details are unique for each type of incident (CBRNE)*

- Response Timeline Requirements to Chemical and Biological Terrorism are totally driven by the clinical pathways of the threat agents!

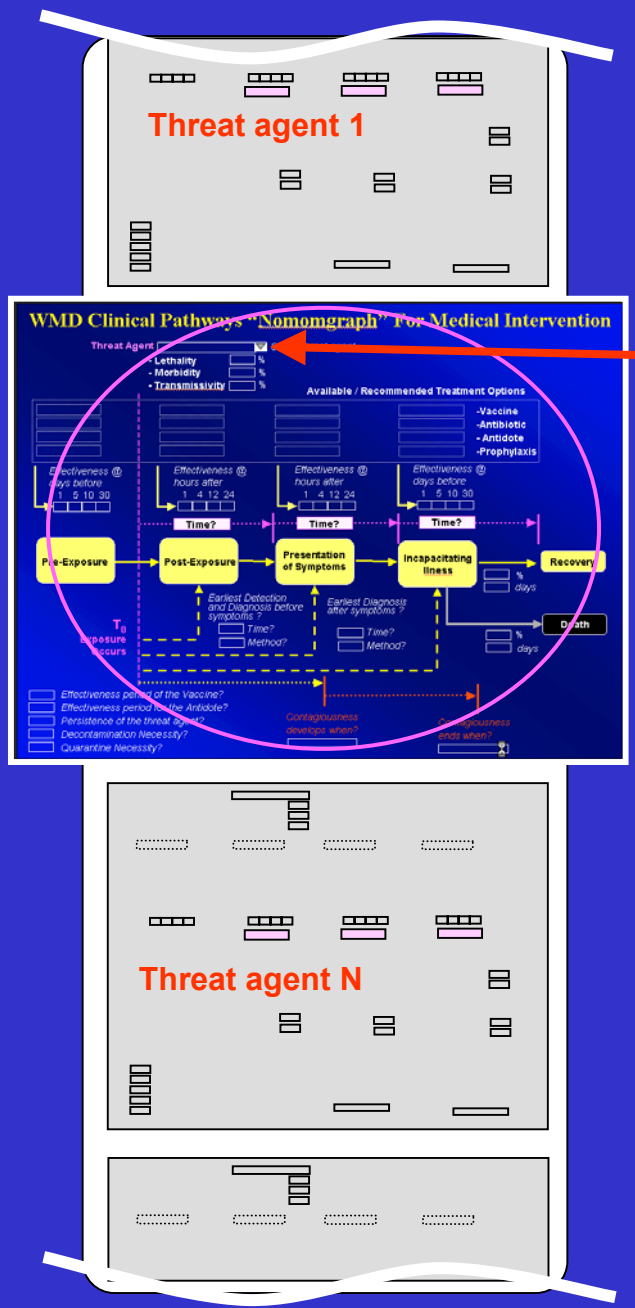
Timeline For Medical Intervention

of Terrorist / Warfare Agents



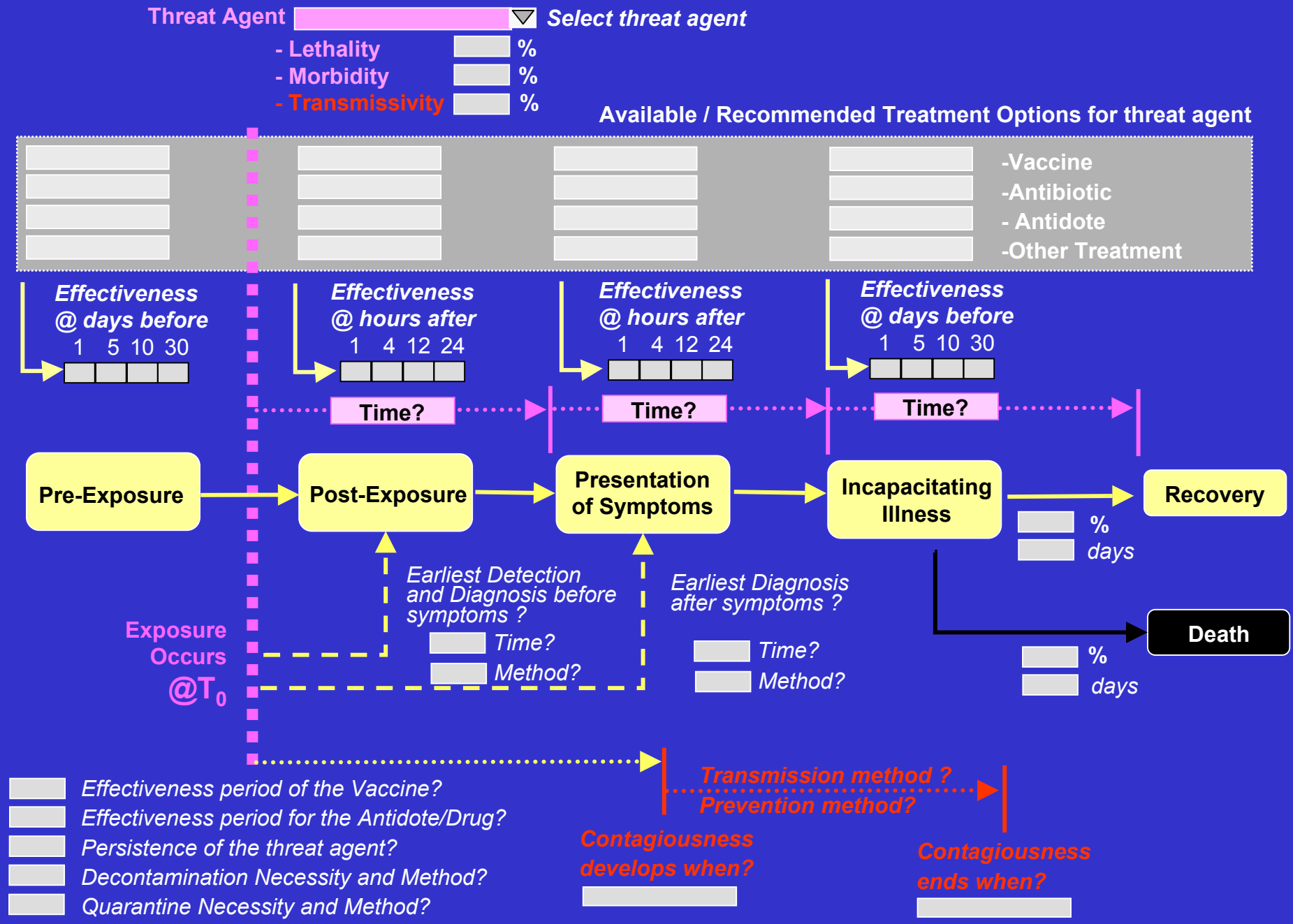
From: Greenwood, D. P., A Relative Assessment of Putative Biological-Warfare Agents: Technical Report 1040, (Lexington, Massachusetts: Lincoln Laboratory, Massachusetts Institute of Technology, 17 July 1997).

WMD Clinical Pathways “Nomomgraph” is Critical Decision Aid

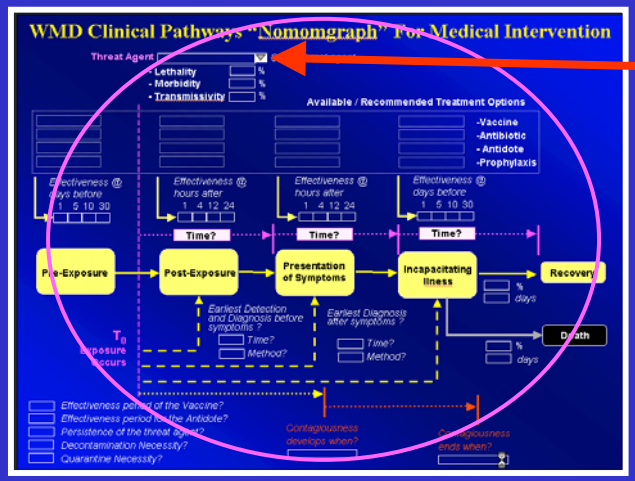


Clinical data of effects and critical treatment timing for selected threat agent

WMD Clinical Pathways "Nomomgraph" For Medical Intervention



Threat Agent ID & Treatment Options is Key Scenario Driver



The threat agent and its effects on victims across time are the primary scenario event drivers

. . . and also key to measuring emergency response and treatment effectiveness